A Work Project, presented as part of the requirements for the Award of a Master Degree in Finance from the NOVA – School of Business and Economics

EQUITY RESEARCH BOEING

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A project carried out on the Master in Finance Program, under the supervision of:
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3rd January, 2020

Abstract

Boeing is the largest aerospace and defense company in the world. The 737 MAX grounding lead to a very hard year for the company and menaced its status as the leading company in the industry. A company and industry analysis was conducted to support the discounted cash flow valuation that was made. The trends of the industry and the way the company will relate to the latter, were incorporated in a valuation model that states a clear BUY recommendation for this stock, predicting a current undervaluation due to the 737 MAX grounding.

Keywords: Boeing, Aerospace and Defense, Equity Research, 737 MAX Grounding

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BOEING

COMPANY REPORT

AEROSPACE & DEFENSE

3 JANUARY 2020

STUDENTS:

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SEBASTIÃO CORREIA 33951@novasbe.pt

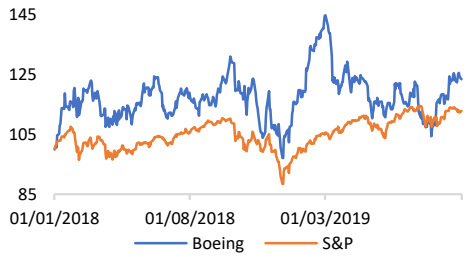
The 737 MAX return will be decisive

Recommendation:	**BUY**
Vs Previous Recommendation	-
Price Target FY20:	**401.12 €**
Vs Previous Price Target	-
Price (as of 31-Dec-2019)	**325.76 €**

Reuters: BA.N, Bloomberg: BA:US

52-week range ($)	292.47-446.01
Market Cap ($B)	183.335
Outstanding Shares (m)	562.791

Source: Bloomberg



Source: Bloomberg

(Values in $ billions)	2018	2019E	2020F
Revenues	101.13	79.80	121.07
Gross Margin	19.5%	10.6%	15.0
Operating Profit	11.99	1.51	9.54
NOPLAT	10.72	1.19	8.06
ROIC	47%	3%	22%
FCF	8.93	0.73	16.11

Source: Bloomberg and analyst estimates

A successful return will take Boeing into full growth

- **Commercial Airplanes (60.0% of revenue):** In a growing market that cannot be fully supplied by Airbus, Boeing will recover from the 737 MAX scandal. The grounding had a big impact on the company stock price – which fell over 18% – besides the reputational impact. All in less than six months. Once the grounding is surpassed, the company will rapidly return to fight for the lead with Airbus. Operating revenues will start to grow and expenses with R&D will continue to be a very important investment for the company as it will help prevent situations like the 737 MAX grounding to happen again.

- **Defense, Space & Security (22.9% of revenue):** With the projections of growth of the US military spending – reaching $700 billion per year in 2025 – and being the second largest contractor from the US Department of Defense, this segment is in route for stable growth with a 1.7% CAGR until 2027. Investment in the Air domain takes the biggest part of the budget for the DoD for 2020, being around $58 billion, representing around 9% of the total budget.

- **Global Services (16.8% of revenue):** In a very fragmented market, where there are no leading contenders and with Boeing's prevision for this market segment to be worth over $3 trillion between 2019 and 2028, the firm will be able to gain market share, either through organic growth or acquisitions. The segment is set to grow at a 5.9% CAGR until 2027.

Company description

Founded in 1916 by William E. Boeing, The Boeing Company is the world's largest aerospace & defense company and biggest American exporting manufacturer with headquarters in Chicago. The company sells commercial jetliners, defense, space and security systems and provides service or aftermarket support in more than 150 countries.

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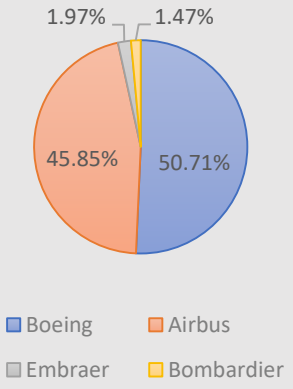
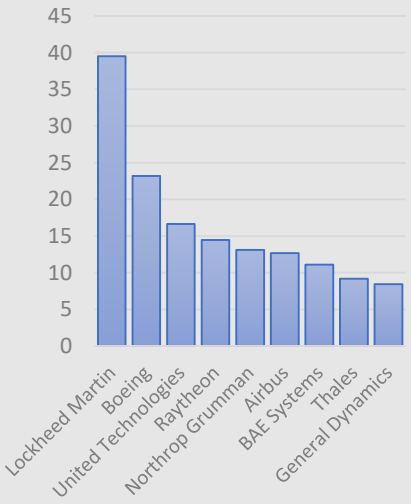
Exhibit 1: Commercial airplane revenue by company (%) in 2018



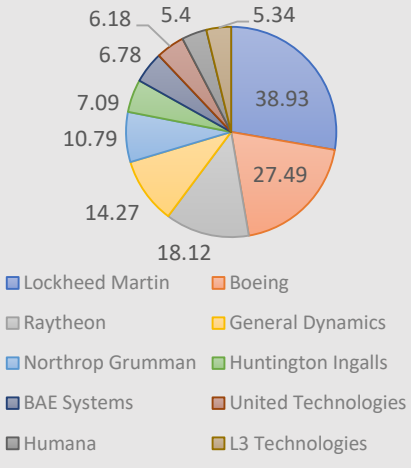
Source: Company's annual reports

Exhibit 2: Defense, space & security revenue by company (billion $) in 2018



Source: Company's annual reports

Exhibit 4: Top 10 largest U.S. DoD contractors (billion $) in 2018



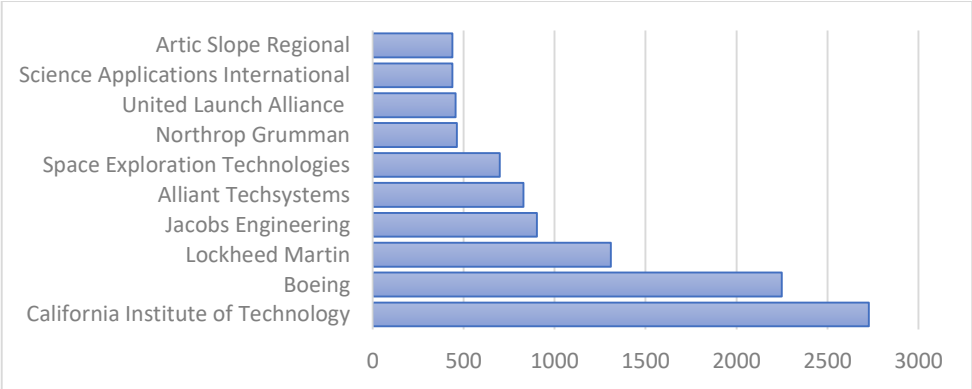
Source: Statista

Executive summary

Boeing is the world's leading aerospace and defense company with a revenue of over $100 billion in 2018. This revenue is mostly related to three different business lines: Commercial Airplanes, Defense Space and Security and Global Services.

Commercial airplanes' segment enjoys a competitive duopoly with Airbus, as shown in exhibit 1 and as of 2018, together they control over 95% of the market. Defense, Space and Security is in a more competitive market, as it is possible to understand based on exhibit 2, but being one of the largest contractors for the US Department of Defense (DoD) and NASA (see exhibits 3 and 4) makes Boeing one of the biggest players in the market. Global services' segment is in a very fragmented market, which is characterized by the costumers' choice between in-house maintenance and outsourcing. Boeing Global Services has a strategy of providing a complete and cost competitive service around the world. Due to the synergies with the other business lines of the company, Boeing has a competitive advantage through the manufacturing knowledge, worldwide presence and size to acquire other companies, which will lead to a gain in market share. However, in 2019 the company had a major step back with the 737 MAX grounding, which lead the company to a terrible year in the commercial airplanes' segment and in the company as a whole, due to its importance.

Exhibit 3: Top 10 largest U.S. NASA contractors (million $)



Source: Statista

Boeing's revenue will only grow at 1.6% CAGR until 2027, nevertheless, the key for the company's growth will be the increase in the operating margin, as this figure will almost double during the period of analysis. Operating cost reduction will be related to the gradual decrease in the cost of goods sold that will become stable, representing 80% of revenue from 2025 onwards, against the 85% in 2020. This effect will be partially offset by the increase in R&D that is forecasted to have a growing trend of 3% YoY, having peaks in years when the company launches new

products. Other operating costs are not expected to have any major effect on this margin.

The target price for Boeing in 2020, according to the valuation conducted is $401,12 per share.

Boeing has more than 15 thousand patents in his possession.

Source: Boeing's website

Company overview

Boeing is a multinational corporation in the sector of A&D – Aerospace and Defense – which is a sector that encompasses a vast variety of activities. The company started in 1916, when William E. Boeing founded the Aero Products Company right after creating a single-engine, two-seat seaplane with the U.S. navy officer, Conrad Westervelt.

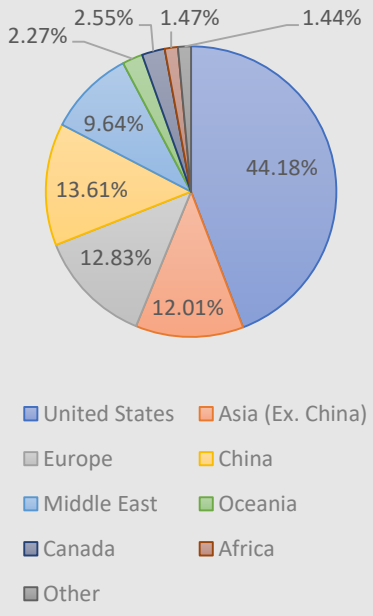
"The company has 11 research and development centres around the world".

Source: Boeing's website

Even though A&D is a vast market, there are two companies that stand out: Boeing and Airbus, since they own over 95% of the global commercial airline industry, which is a very influent and strong segment within the overall sector.

Since A&D is a heavy manufacturing industry, it is not easy for a company to install new productive capacity rapidly and economies of scale are crucial in order to manufacture with competitive costs. Thus, there are high barriers to entry and it is not easy for a smaller player to gain market share.

Exhibit 5: Revenue by geography in 2018 (%)



Source: Boeing's annual report

Company description

Boeing is the largest aerospace company in the world. Based in the United States, it is the country's biggest manufacturing exporter, selling its products to every continent in the world (see exhibit 5), with customers in over 150 countries and employees in 65 different countries, employing more than 150,000 human resources[1]. Boeing is characterized by its continued innovation, spending over $3 billion every year in research and development, leading to the expansion of its product lines in order to meet market changes and, most importantly, its customers' needs.

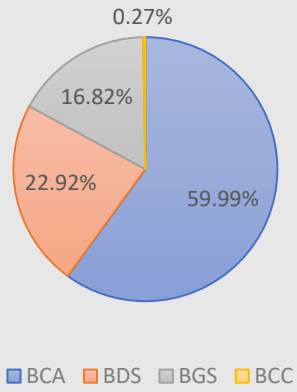
The company is divided in four different business lines: BCA, BDS, BGS and BCC.

- Boeing Commercial Airplanes (BCA)

Boeing Commercial Airplanes is engaged in the manufacturing and selling of commercial aircrafts. This line offers a wide range of airplanes that represent

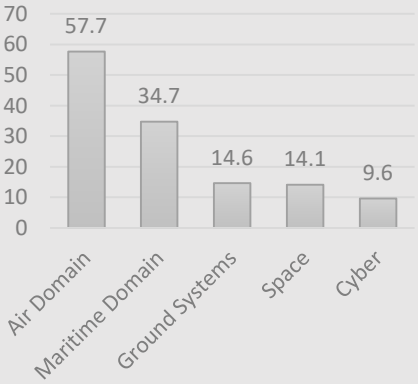
1 Boeing's Annual Report 2018

Exhibit 6: Revenue by segment in 2018 (%)



Source: Boeing's annual report

Exhibit 7: U.S. DoD budget 2020 – top 5 investment items (billions of dollars)



Source: Under Secretary of Defense (Comptroller)

almost half of the world's fleet. Moreover around 90% of the world's cargo is carried onboard of Boeing's airplanes [2].

The company's market share was 50% in 2018 with an operating margin of 12.98%, outperforming Airbus that could only deliver an 8.95% margin in the same year[3]. Since 2014, Boeing's revenue has grown 1.21% while Airbus's grew 13.45%, in absolute terms, nevertheless, the American company was always able to deliver higher operating margins, showing a higher focus on profitability.

- Boeing Defense, Space and Security (BDS)

Boeing Defense, Space and Security is a very wide segment, that is committed to provide innovative solutions for military and space's needs. Everything related to strategic defense and intelligence systems is under the purview of BDS. With all the concerns about cybersecurity emerging nowadays and the increase in supply and demand of intelligent automation systems, it is crucial that Boeing can continue developing solutions regarding cybersecurity, intelligence and satellite systems. The most important customer of BDS is the United States DoD, which accounts for the majority of the revenue for this business line[4].

As shown in exhibit 2, in this segment Boeing emerges as the second biggest player in the market, nevertheless, the company is not as profitable as its competitors, as its operating margin was almost half of the combined margin of the rest of the Top 5 in the market, since Boeing delivered a 6.87% margin in 2018 while its competitors achieved 12.28%. Although 2018 was the year with the worst operating margin of the segment in the last five years, that had been stable around 10%, it can be explained by the 12.81% growth the company experienced. Nevertheless, while analyzing previous years, Boeing still shows a smaller profitability compared to its competitors, but not a higher growth. Since 2016, Boeing's revenue grew 14.94% while its competitors combined revenue grew 16.87%, in absolute terms. Although this segment is almost in line with its competitor's growth, the operating margins still need some improvement.

As can be seen in exhibit 7, the air domain represents the biggest investment of the DoD budget, representing about 9% of the total budget. It is important to note that for 2020 the country is paying more attention and investing a significant amount in cybersecurity capabilities, modernizing DoD's cloud environment and

2 Boeing's Website
3 Airbus' annual report
4 Boeing's annual report

supporting cyberspace operations[5]. Thus, it is noticeable that the U.S. will keep investing in defense regarding aircrafts and encompass cybersecurity solutions.

- Boeing Global Services (BGS)

Boeing Global Services provides aftermarket support regardless of the original equipment's manufacturer, allowing its customers' aircrafts to operate at high efficiency. The company counts with more than 14,000 aircrafts supported all around the world and with almost 3 million aircraft health maintenance condition evaluations per day[6]. It is also in BGS that supply chain and logistics management are placed, which are very important parts of the business since it is a frailty of Boeing and of the A&D industry in general, as it is hard to get to the right level of operational excellence and, at the same time, manage all the challenges that come from a growing industry. To enhance Boeing's capacities in this field, Boeing strategically acquired *KLX Aerospace Solutions* (a main global provider of aviation parts and services) in 2018[7].

The BGS – Digital Solutions & Analytics saved $1 Billion per year on account of crew-scheduling analytics.

Source: Boeing's website – "Updates to BGS Ecosystem Infographic"

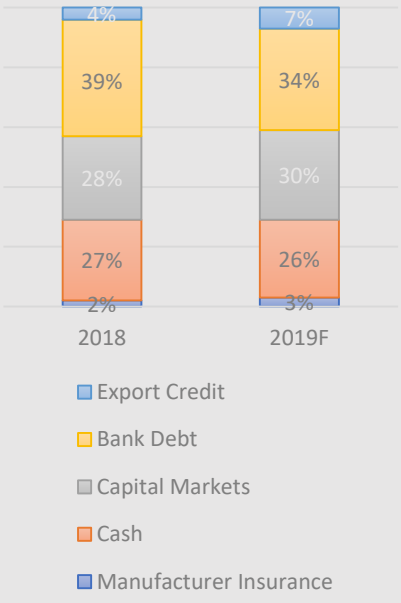
In a market composed by several small players acting in certain regions of the world, – such as airlines acting in their base location – Boeing's network around the world, due to the two biggest business lines of the company, is an important competitive advantage. Due to Boeing's worldwide presence, it is possible to supply this service globally while many of the competitors are not able to do so. This market is expected to grow at a 3.5% rate in the next ten years[8], and Boeing is highly outgrowing the market, since 2018 was its first complete year as a stand-alone business and BGS's revenue grew 16.71%. Moreover, as Boeing creates a substantial cash flow yearly – almost $9 billion in 2018 – this can be used for the acquisition of strategic players in this market, to gain market share.

- Boeing Capital Corporation (BCC)

Boeing Capital Corporation provides financing solutions ensuring that Boeing's costumers experiencing liquidity issues, have the financing needed to purchase the company's products.

Currently, the aircraft financing market is composed, as can be seen in exhibit 8, by manufacturer insurance, cash, capital markets, bank debt and export credit. Although bank debt accounts for the biggest source of funding in the aviation industry, it is expected that the market will be more diversified in terms of liquidity

Exhibit 8: Aircraft Financing Market in 2018 and 2019 (forecasted by Boeing)



Source: Boeing's Website

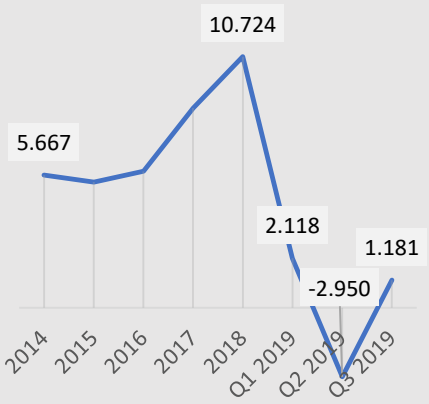
5 Under Secretary of Defense (Comptroller) – Defense Budget Materials
6 Boeing's Website
7 Boeing's Annual Report 2018
8 Boeing's 2019 Service Market Outlook

from different sources. Thus, bank debt will keep on having a big impact, but the trend is for the type of funding to disperse.

- 737 MAX Grounding

The Boeing Commercial Airplanes segment is the biggest revenue enhancer of the company and the 737 family has constantly been the best-seller of BCA. More than half of the company deliveries are from the 737 family – close to 68% of the total deliveries, on average, since 2014 – and once the grounding of the new 737 MAX is lifted, it will continue to be the company's most sold family. The two accidents – having the first occurred in October 2018 and the second in March 2019, resulting in the deaths of 189 and 157 people, respectively – involving this plane resulted in the order of grounding all the models of the plane by the aviation authorities around the world. The system Boeing used to overcorrect the direction of the aircraft to enhance the pitch stability and make this plane feel like any other 737 – the Maneuvering Characteristics Augmentation System (MCAS) – had significant malfunctions during flight, that lead to these two accidents. This controversy had a big effect on the results of the 2nd and 3rd quarter. Indeed, the 2nd quarter had a negative result of $2.9 billion due to the charge of $5.6 billion to compensate airlines, which lead to the worst quarterly result ever, as showed in exhibit 9. However, updates on the MCAS and the flight control computer software for further protection, redundancy and safety are being conducted under the supervision of the aviation authorities[9].

Exhibit 9: Boeing's NOPLAT - 2014 to 2019Q3 (billions of dollars)



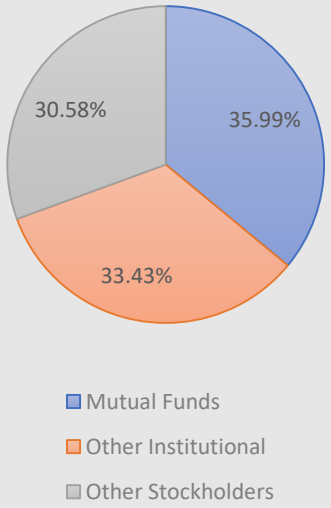
Source: Boeing's Annual reports

Albeit the sales of the 737 MAX are currently interrupted and there is still a lot of uncertainty about when they will be restarted, this interruption will not have a negative impact on the valuation, since the most likely outcome is for the grounding to be lifted in 2020. Deliveries will be even greater in 2021 due to the units that were built and could not be sold during the grounding. However, what will have a negative impact on the valuation are the effects of the reputational loss suffered – in a Barclays survey only 19% of the respondents said they would be willing to fly the 737 MAX immediately after its return to service[10] – showing that the aviation authorities permission for the aircraft to fly is only the first step for a successful return. Another negative effect is the increase in production costs due to the reduction of the production rate, that Boeing predicts to gradually increase to the pre-grounding rate by late 2020[11]. Despite this prediction, it is possible for this to require more time than expected as the whole process is taking longer than predicted by the company. This delay in the return of the MAX lead to the dismissal

9 NYTimes – "Boeing 737 MAX: What's Happened After the 2 Deadly Crashes"
10 Airline Ratings – "Survey finds only 1 in 5 will be comfortable flying the MAX"
11 Boeing's website

of the CEO, Dennis Muilenburg, in the 23rd of December and will lead to a production halt in the beginning of 2020. Dave Calhoun, that had already been appointed as chairman in October, was chosen to "restore the confidence" in the company[12].

Exhibit 10: Boeing's Shareholder Structure



Source: Boeing's Annual Report 2018, CNN Business and MarketScreener

Shareholder structure

The company's business is handled by its managers, employees, corporate officers and led by the chief executive officer, Dave Calhoun.

The principal market for the firm's common stock is the New York Stock Exchange (NYSE), even though it is also present in the Dow Jones Industrial Average, stock savings plan (DJIA/PEA), S&P 100, S&P 500, Stoxx Americas 100, Stoxx Global 200, Stoxx NorthAmerica 50 and Stoxx USA 50[13].

As of the 1st of February 2019, there were 104,376 shareholders of record. Around 55.6% of Boeing's equity is free float, corresponding to 44.4% of treasury shares related to the share repurchase programs the company has been performing. As of the 15th of November 2019, institutional investors own the majority of Boeing through the 69.42% of the outstanding shares they keep under control. Therefore, the board of directors is likely to pay more attention to their preferences, which is a sign of credibility for professional investors. Mutual funds hold 35.99% and other institutional investors hold 33.43%[14].

The 4 individual shareholders with the greatest number of shares are Dennis Muilenburg (former president and chief executive officer of Boeing), Greg Smith (chief financial officer and executive vice president of enterprise performance & strategy), Leanne Caret (president and CEO of BDS) and Kenneth Duberstein (member of Boeing's board of directors)[15].

"Aerospace & Defense industry has been key factor for driving innovations globally".

Source: Medium – "Innovation in Aerospace & Defense (A&D) Industry"

Sector Overview

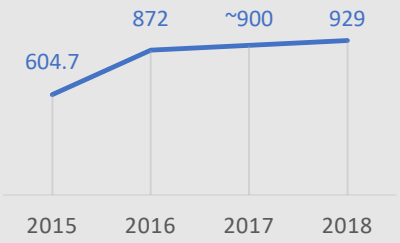
Macroeconomic Environment

The Aerospace and Defense industry encompasses companies that produce commercial and military aircraft, commercial services for airports, weapons, satellites, electronic and defense systems, advanced information and communication systems and launch systems. Besides all these, the company

12 Boeing's Statement – "Boeing Announces Leadership Changes"
13 MarketScreener
14 Boeing's Annual Report 2018; CNN Business and MarketScreener
15 Investopedia

being analysed also provides performance-based logistics and training. The A&D sector is frequently divided into two different segments: defense and commercial aircraft.

Exhibit 11: A&D Industry Sales (billions of dollars)

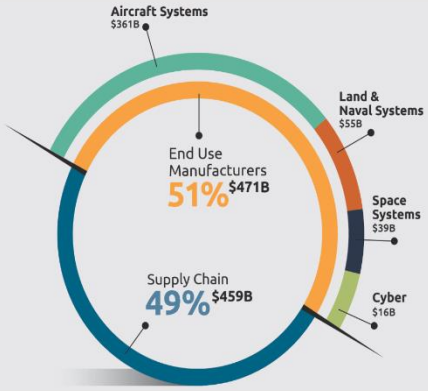


Source: Aerospace Industries Association; "The Aerospace Business – Management & Technology" by Wesley Spreen

Since 2010, the sector has been having a sustained growth, reaching more than $929 billion in 2018[16]. Exhibit 11 shows the evolution in industry sales since 2015. As it is possible to see from exhibit 12, 51% of industry sales represented End Use Manufactures in 2018, mostly Aircraft Systems that accounted for $361 billion of a total of $471 billion. In 2015, End Use Manufacturers represented 58% of total industry's sales and in 2016 decreased to 52%[17]. Over the years, Supply Chain has become more representative in the industry's sales, since it is a known weakness of the overall sector and improvements are being made by the A&D industry's companies.

In 2018, the sector broke the record of revenue and profit, reaching a revenue of $760 billion and operating profit of $81 billion. Both defense and aerospace sectors are expected to keep growing in revenue and operating profit in 2019[18]. Furthermore, aircraft deliveries and aircraft aftermarket are expected to grow as well as the defense spending.

Exhibit 12: A&D Industry Sales in 2018 (billions of dollars)



Source: Aerospace Industries Association

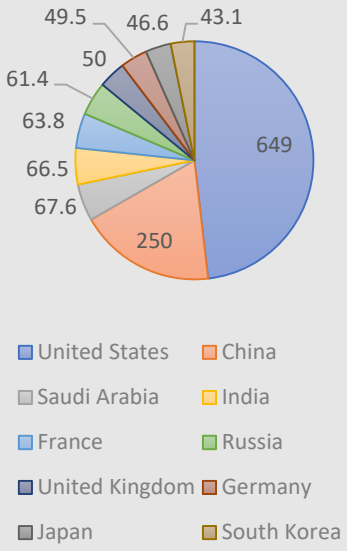
- ## Mergers and Acquisitions in A&D

The A&D sector is comprised by several small companies and fewer larger ones. It is possible for a company to grow either organically or through M&A activity. Organic growth is more time-consuming and, in some cases, when a company wants to achieve it through the entrance in a new geographical market, it is not possible or very hard to achieve due to the matureness of the market. For instance, the major Original Equipment Manufacturers (OEMs) are based in the United States and many tier suppliers are choosing to enter the American market through M&A. Thus, many times M&A is the favoured strategy for companies to grow, especially for smaller companies trying to compete with bigger players. The biggest companies in the market use this strategy to grow and at the same time to guarantee that the smaller competitors are not able to become dangerous competitors in the future.

2018 was a very active year for the M&A ecosystem in the A&D industry with a total of $127 billion in deals representing a record for the industry. Nevertheless, 2019 activity is on track to achieve a new record with $120 billion worth of

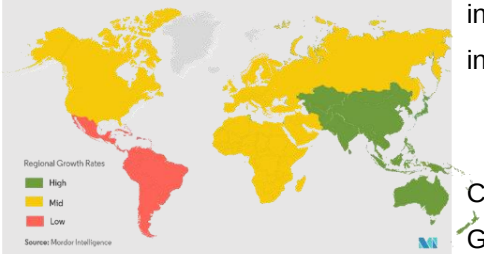
16 Aerospace Industries Association – 2019 Facts & Figures
17 "The Aerospace Business – Management & Technology" by Wesley Spreen
18 Pwc – "Aerospace and Defense Hits Industry Hits Record Revenues and Profits in 2018"

Exhibit 13: Top 10 military spenders in 2018 (billion $)



Source: Statista

Exhibit 14: Commercial Aircraft Market – forecasted growth rate by region (2019-2024)



Source: Mordor Intelligence

announced transactions in the first six months of the year[19]. In 2019, the biggest deal approved was the merger of Raytheon and UTC, which is predicted to be completed in 2020 and, together, the companies will be a massive government defense contractor with close to $74 billion in pro forma 2019 sales. In June of 2019, Boeing entered into an agreement for the acquisition of EnCore Group – an aerospace interiors company – with the intent of going forward with one of the company's objectives: innovate and provide a better end-to-end value to its customers[20].

As A&D is a very competitive market and hard for smaller companies to gain market share organically, middle market deals (below $500 million) are the most common among the industry, even if the larger deals are more highlighted[21].

- Defense

Regarding the defense industry, one of the reasons the sector keeps on growing is President Trump, that set the Department of Defense baseline budget at $664 billion in 2019, confirming the investment from his administration in defense, as this budget has increased every year during his presidential term. Also, in Europe and Asia, defense budgets increased, although not as much as in the U.S. The second country with higher defense spending is China, with a total of about $259 billion[22]. Globally, defense spending increased more than $80 billion in 2018, totalizing around $1.67 trillion[23], which is partially explained by the current conflicts worldwide. Significant examples are the evolving global environmental threat, terrorist threats, that continue to persist, the modernization of the military forces from China and the activities in the South China Sea and Pacific region, which are causing tension and, although North Korea's nuclear missile program diminished in 2018, it still remains a threat. All these events are contributing for the investment in defense to guarantee a secure environment worldwide.

- Commercial Aircraft

Commercial air travel is expected to keep growing throughout all regions of the Globe and until 2023, this market is anticipated to register a CAGR of about 7%[24]

19 AlixPartners – "Record M&A activity in aerospace and defense continues in 2019"
20 Boeing's Website
21 "Mergers and Acquisitions (M&A) in Aerospace and Defense Market – Growth, and Trends" by Mordor Intelligence
22 Business Insider – "Worldwide military spending rose in 2018 – here's who's spending the most and who's cutting back"
23 IISS, Military Balance Blog – "On the up: Western Defence Spending in 2018"
24 MarketWatch – "Commercial Aircraft Passenger Service Unit (PSU), Market 2019, Size, Share, Demand, Revenue, Manufacturers, Trends, Growth, Research, Forecast to 2023"

As of December 2019, Boeing announced it had around 400 stored airplanes.

Source: Business Insider – "Photos show why Boeing was forced to stop production of its grounded 737 MAX"

"Moody's cut Boeing one level to A3 (…), noting the uncertainty around when the company's bet-selling aircraft will return to service (…)".

Source: Bloomberg - December 20, 2019

Exhibit 15: "Wall street analyst still backing Boeing - Share of analyst buy/hold/sell ratings, along with share and target prices"

Source: CNBC

and commercial airplane markets are valued at $6.3 trillion over the next 19 years[25]. Thus, it is expected that aircraft deliveries will continue to grow.

Pursuant to, the global fleet is projected to achieve a total of 39,175 aircraft by 2029. From 2019 to 2024 the in-service fleet is predicted to grow around 3.9% yearly and 3.3% thereafter, until 2029. The principal volume of the fleet will be narrow body jets like Airbus' A320neo and Boeing's 737 MAX, even with the 737 MAX production only getting back to normal in the end of 2020 or beginning of 2021. However, surpassed that unfortunate event, it is forecasted that almost 13,800 737MAX and A320neo will be delivered until 2029 and at that time, 2/3 of the global fleet will be composed by narrow body jets[26]. Wide body airplanes will also gain importance in the world's fleet, since transatlantic flights are increasing (as airlines are increasing its transatlantic routes and capacity)[27] and these airplanes have the best characteristics for this kind of flights.

In what concerns the Commercial Aircraft Market growth, the region that will grow the most is the Asian continent, as this is the most populated area in the world and its fleet is still not big enough to supply the growing demand for flights. This trend that has been felt and it is believed to persist, is highly supported by countries like China and India, that are expected to play an important role in the commercial aircraft sector as they are the countries with the highest fleet growth forecast in the world[28].

- Impact of the 737 MAX Grounding

The 737 MAX grounding carry costs not only to the company in particular but also to airlines, especially those who work exclusively with Boeing. American commercial airlines such as Southwest Airlines, American Airlines and United Airlines, together, own 72 of these planes and due to the incidents, these companies had more than 50,000 flight cancelations and lost millions of seating capacity. The impact on the operating profit for these 3 companies is estimated to be a negative impact of $600 million combined. The results from the 3rd quarter of 2019 of Southwest Airlines showed a negative impact of $210 million on pre-tax income and for American Airlines the negative impact was of $140 million. Regarding the results of the operating profit for the fiscal year of 2019, both

25 Boeing's Annual Report 2018
26 Marsh and McLennan Companies - "Global Fleet & MRO Market Forecast Commentary" by Oliver Wyman
27 Several news from different companies. Egs." Aer Lingus Rejigs Transatlantic Capacity For 2020" from SimpleFlying & "Air Transat To Increase Transatlantic Capacity" from Buying Business Travel
28 "Commercial Aircraft Market - Growth, Trends and Forecast (2019 – 2024)" by Mordor Intelligence

companies are expecting to have a negative impact of around $435 million and $540 million, respectively[29].

Although the damages caused by the grounding are impossible to be reverted, Boeing established $100 million to help the families of those who were in the accidents and it is also negotiating compensations for its damaged customers[30]. As a result of the discussions that are still happening with some airlines (such as American and United Airlines), Boeing has already established a compensation of about $125 million for Southwest Airlines[31].

All in all, Boeing is still a strong company in the market, and it is expected to surpass the grounding. Analysts of Wall Street think that the company will recover and thus, as can be seen in exhibit 15, they currently don't have a sell rating.

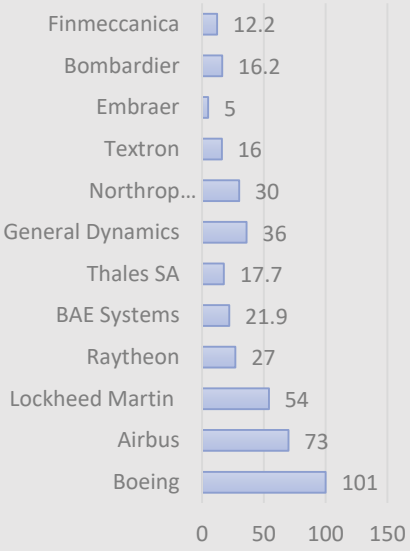
Comparables[32]

As mentioned before, the Aerospace and Defense industry consists of several small companies and larger ones. However, there is no other company that is so omnibus as Boeing, meaning that most of the companies that are competing against Boeing are only focused on one part of the industry. Either they are mostly focusing on commercial airplanes or in defense, and none of the competitors provide repair and support independently of the original manufacturer of the aircraft.

The competitors used for the purpose of the present valuation are Lockheed Martin, Airbus, General Dynamics, Raytheon, Northrop Grumman, BAE Systems, Textron, Thales SA, Embraer, Bombardier and Finmeccanica.

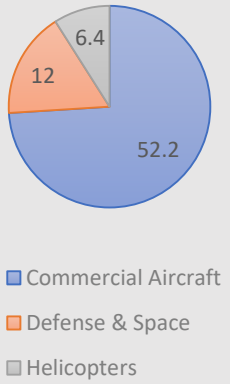
The most direct peer to Boeing is Airbus, a French company that had €63.7 billion in revenues in 2018 – approximately $72.9 billion – such that 17% are from Airbus Defense and Space, 74% of the revenues involve commercial airplanes and 9% from Airbus Helicopters. The Commercial Aircraft business' segment of Airbus also includes the equivalent of BGS, but again, the maintenance engineering is only available for their products. Nonetheless, Boeing has a business line that surrounds defense, space and security, Airbus has two different business lines: one for defense and another for space with different products in each of the business segments. In what concerns BCC, Airbus does not have any business line that resembles to this. Instead, and only in specific cases, the company

Exhibit 16: Comparables Revenues in 2018 (billions of dollars)



Source: Companies Annual Reports

Exhibit 17: Airbus revenue per business line in 2018 (billions of dollars)



Source: Airbus Annual Report

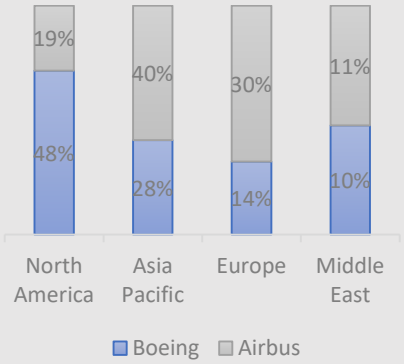
29 Market Realist – "Boeing: Rising Costs, 737 MAX Grounding Continues"
30 Boeing's Annual Report 2018
31 Reuters – "Southwest reaches partial settlement with Boeing over projected 737 MAX damages"
32 Data from comparable companies were obtained from the respective annual reports

"They can in theory switch orders from Boeing to Airbus – but they will be waiting at the back of the Airbus queue"

Robert Stallard, Vertical Partners Research

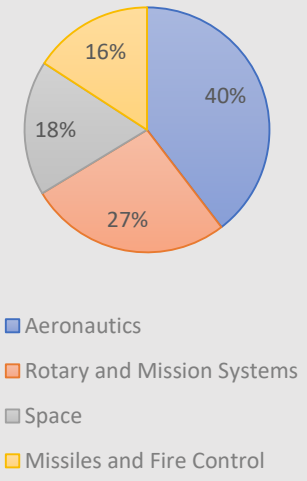
Source: Financial Times – March 18, 2019

Exhibit 18: Geographic Diversification: Boeing vs Airbus (based on 2018 Revenues)



Source: Aerospace Technology – "Airbus vs Boeing: a tale of two rivals"

Exhibit 19: Lockheed Share of Net Sales per business unit in 2018



Source: Statista

participates in financing the aircraft in stake for its costumer. However, in what concerns the civilian helicopters' segment, Airbus owns 54% of the market while Boeing does not produce for this market's sector[33].

With Boeing's 737 MAX grounding, the natural substitute for its customers would be the A320neo which would be putting in stake the future of the 737 MAX and impacting the company's results. However, this model cannot supply the whole market since the company does not have the industrial capacity to produce the roughly 1,400 narrow bodies that are demanded by airlines every year. Moreover, the company has a backlog of 5,962 (as of February 2019) – where 5,814 were for the A320neo model and 148 for the most recent optional model A320ceo – meaning that any order made currently will only be delivered in a few years[34]. Besides this, also in 2018, Airbus suffered a temporary grounding of 14 A320neo aircrafts because of the P&W engines and thus, the choice may not be obvious for many customers and according to Morningstar analysts, it is expected that customers keep their 737 MAX orders. Nonetheless, it is not likely for the company to receive more orders until the grounding is lifted.

In terms of geographic diversification Airbus is slightly better than Boeing (see exhibit 18), leading the Asia-Pacific area, which can be a changing point in the long-term. However, regarding revenue diversification, Boeing is less risky as 60% of its revenue comes from the Commercial Aircraft segment compared to the 83% of Airbus revenues regarding the company's commercial aircraft and helicopters segment[35].

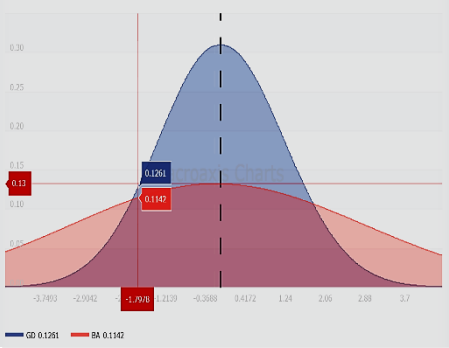
Together, Boeing and Airbus hold over 95% of the commercial airplanes market share and even though Airbus is a strong competitor with big expansion capabilities, besides the presented strengths, Boeing is still 1.4 times bigger and is present in more 90 countries than Airbus.

Regarding BDS, Boeing has some important players in the market that should be mentioned in the report, such as Lockheed Martin, Raytheon, General Dynamics (GD) and Northrop Grumman, which are the biggest competitors regarding this business segment.

Lockheed Martin is the biggest competitor, since it is the leading company in the defense industry, with 73% of its business earned on that segment. The American company achieved $40 billion in revenue in 2018 in the business lines that are included in this industry. With a growing trend of 8% in the two previous years and

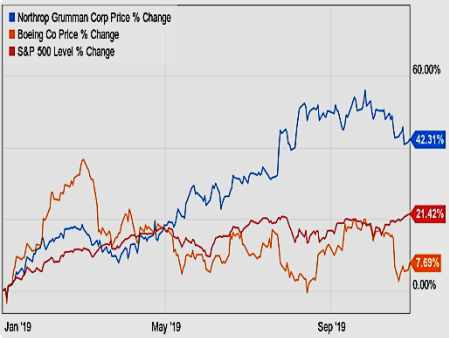
33 Aerospace Technology – "Airbus vs Boeing: a tale of two rivals"
34 Financial Times - "Airbus cannot build fast enough to replace Boeing's 737 Max"
35 Aerospace Technology – "Airbus vs Boeing: a tale of two rivals"

Exhibit 20: General Dynamics vs Boeing Volatility



Source: Macroaxis

Exhibit 21: Change in Price per share (in %) of Boeing vs Northrop Grumman vs S&P 500



Source: The Motley Fool – "Better Buy: Boeing vs. Northrop Grumman"

an operating margin constantly over 11.5%, Lockheed shows not only a higher growth than Boeing but also higher operating margins. This is a benefit gained through the higher focus in the defense industry.

Raytheon, also an American company, is a strong competitor and it will be even more as it will merge United Technologies Corporation, creating the second largest defense company, in anticipation of regulatory approval[36]. As of 2018, Raytheon showed an increase in revenue of 6.75%, compared to the year before, recording over $27 billion in revenue. During 2019, the company's stock price rose 29.35%, reaching a value of $220.59 per share. United Technologies Corporation stock prices also rose 25.5% achieving the total amount per share of $150.34[37].

General Dynamics is an American company and a big competitor as it accounted almost $36 billion in revenues in 2018, where 22.97% of the revenue of the company is present in the Aerospace segment. The company presents a growing pattern as it has been improving its revenue more than 4% year over year reaching $9.6 billion in revenue in the 2nd quarter of 2019 and more than $2.2 billion in orders[38]. However, as can be seen in exhibit 20, Boeing has lower volatility when compared to General Dynamics, therefore Boeing is less risky to invest and has a price reasonably stable in comparison to GD. Besides the presented facts, Boeing has a very diversified portfolio compared to the mentioned competitors.

Northrop Grumman, also located in the United States of America, had around $30 billion in revenue in 2018. Even though it is an A&D industry company, it is mainly focused on the Defense segment of the market. In the 2nd quarter of 2019 company's sales rose to around $3.4 billion year over year, presenting an increase of 1.6% compared to the previous period[39]. On the 3rd quarter of 2019 Northrop Grumman increased its earnings per share by $0.70, reaching the total amount of $5.49 per share. However, also in the 3rd quarter the company's backlog grew to $65 billion, organic sales grew by 5% but total revenue only reached $8.48 billion, $80 million less than what the company expected. The firm justified the decline based on completion timing issues, concerns with the company's B-2 modernization program and problems in commercial space[40]. As can be seen in exhibit 21, Northrop Grumman price per share has been increasing relatively to Boeing's price per share since the first grounding of the 737 MAX. However, the

36 The Wall Street Journal – "Investors Approve UTC-Raytheon Merger"
37 Air Force Technology – "Shareholder green-light Raytheon-UTC merger"
38 CNBC – "There's no business like the arms business: Here's how the top US defense companies did in Q2 earnings"
39 CNBC – "There's no business like the arms business: Here's how the top US defense companies did in Q2 earnings"
40 The Motley Fool – "Northrop Grumman Delivers Reasons for Concerns on its Earnings Report"

results of the 3rd quarter of Northrop Grumman affected the price per share and brought some uncertainties for possible investors.

Valuation

Revenue Forecast

The revenue forecast is crucial for the valuation as many other captions will be dependent on that projection.

- Commercial Airplanes

This segment revenue is tied to the aircraft deliveries and these can be divided in two groups: the 737 family (narrow body) and the wide body deliveries. There is usually a 50% discount over the quoted prices, although this is sensitive to the number of airplanes ordered by each airline, among other variables, thus the average price considered for the 737 family is $50 million and for the others is $150 million. These prices are forecasted to follow the inflation of the U.S. as they are priced in its currency, nevertheless, until 2022 the prices will grow at the inflation rate minus 1 basis point as there have been many airline bankruptcies that are supplying the market with more profitable airplanes due to the lower prices. Thus, there is an incentive for a real price reduction in the short term.

In the wide body group Boeing only competes with Airbus as they are the only two companies producing this kind of airplanes. With a fleet composed by 5,488 airplanes in 2019, corresponding to 20% of the world's fleet, It is forecasted for the narrow body fleet to grow at a 4,4% CAGR until 2024 and 3,4% CAGR from there until 2029[41]. There will also be a substitution of older fleet members that will retire, which is forecasted to represent 790 aircrafts per year until 2029. These will enhance the deliveries of each type of aircraft in its "market share" value, which will lead to the delivery of around 160 wide bodies every year.

Exhibit 22: Average list price for each airplane family

Family	Price (million $)
737	114.71
747	418.8
767	219.1
777	372.28
787	293.07

Source: Boeing's Website

Exhibit 23: Size of fleets and share in the market

Source: Oliver Wyman

Exhibit 24: Wide body revenue forecast (million $)

	2020	2021	2022	2023	2024	2025	2026	2027
Market Deliveries	388	410	427	439	445	411	401	407
Market Share	59%	58%	59%	60%	60%	60%	60%	60%
Boeing Deliveries	229	238	252	263	267	247	241	244
Average Price	151	150	151	154	157	160	163	166
Revenue	34 508	35 711	38 124	40 557	41 853	39 382	39 118	40 472

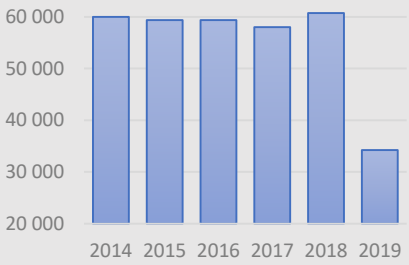
Source: Analyst estimates

41 Marsh and McLennan Companies - "Global Fleet & MRO Market Forecast Commentary" by Oliver Wyman

In exhibit 24, the breakdown of the revenue on wide bodies for Boeing is presented, in which it is possible to understand that the market deliveries will have a stable growth until 2024 and thereafter will decrease as the growth of the fleet slows down. Boeing's market share will have a slight decrease until 2021 as the 787 production rate is reduced by two units a month but will recover its 2018 market share by 2023 as the new 777X is launched, thereafter it is expected to remain stable.

Regarding the narrow bodies, Airbus is still the main competitor but Embraer and Bombardier also produce this kind of aircrafts. Moreover, there is a new entrant, Comac, supported by the Chinese government, that will not be able to compete with the biggest players in this market in the short-term due to the comparative advantage that Boeing and Airbus have through scale economies and experience in the manufacturing of aircrafts. Although, due to its political relations, Comac has the potential to gain market share in Asia, which is the region with the highest perspective of growth. It is forecasted for the narrow body fleet to grow at a 5,5% CAGR until 2024 and 4,4% CAGR from there until 2029. As the narrow bodies represent 60% of the total aircrafts and the projections are for the increase of this figure, the substitution effect will represent on average 490 deliveries a year[42].

Exhibit 25: BCA historical revenue – 2019 expected after 3rd quarter – (millions of dollars)



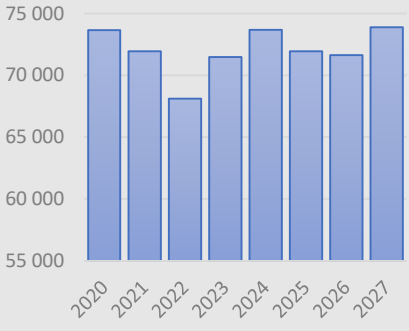
Source: Boeing Annual reports, Analyst Estimates

Exhibit 27: Narrow body revenue forecast (million $)

	2020	2021	2022	2023	2024	2025	2026	2027
Market Deliveries	1 502	1 475	1 381	1 434	1 449	1 458	1 463	1 476
Market Share	52%	49%	43%	42%	42%	42%	41%	41%
Boeing Deliveries	780	723	594	602	609	612	600	605
Average Price	50	50	50	51	52	53	54	55
Revenue	39 144	36 225	29 972	30 919	31 808	32 561	32 498	33 409

Source: Analyst estimates

Exhibit 26: BCA revenue forecast (millions of dollars)

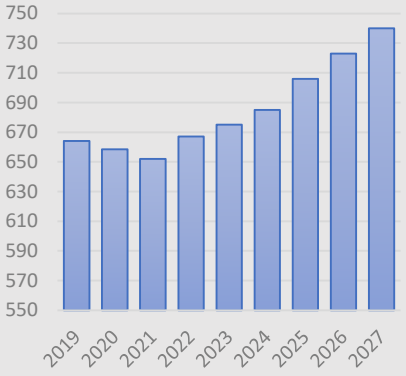


Source: Analyst Estimates

In exhibit 27**,** the breakdown of the narrow body revenue for Boeing is displayed, where it is possible to understand that 2020 and 2021 will be years of abnormal deliveries in the market. This is related to the grounding of the 737 MAX, since while the plane is grounded the company continued to produce 42 aircrafts a month but could not sell any of those, and as the production will be halted in January 2020, Boeing will have around 400 units built during this period. As the grounding is expected to be lifted in 2020, those units will be sold during that year and the next, resulting in more deliveries than production. As these units are sold, deliveries per year will decrease and afterwards from 2022 on, the growth trend will be stable. Boeing's deliveries will follow the first pattern as they are the cause, but afterwards there will be a big loss in market share as the company will only be

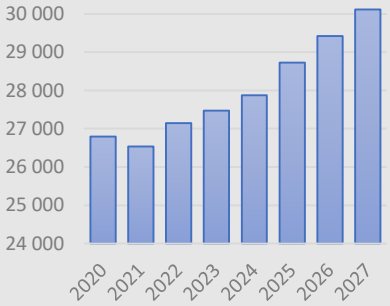
42 Marsh and McLennan Companies - "Global Fleet & MRO Market Forecast Commentary" by Oliver Wyman

Exhibit 28: U.S. baseline military budget forecast (billions of dollars)



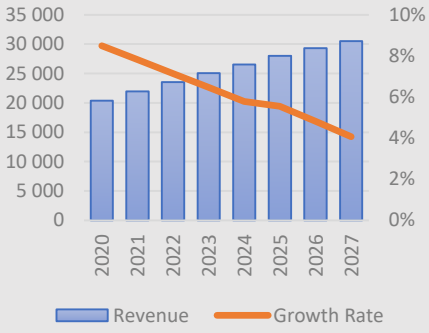
Source: CBO: The Budget and Economic Outlook: 2019 to 2027 and The National Defense Authorization Act of 2020

Exhibit 29: BDS revenue forecast (millions of dollars) and growth rate



Source: Analyst Estimates

Exhibit 30: BGS revenue forecast (millions of dollars) and growth rate



Source: Analyst Estimates

selling its year production again, and from 2022 on there will be a tendency for market share loss due to the launch of the C919 by Comac.

The total segment revenue can be seen in exhibit 27, where it is possible to understand that after the units produced during the grounding are sold, there is a growth trend in revenue that in 2025 and 2026 is not followed, due to the market slowdown and the narrow body loss of market share.

- Defense Space & Security

US customers have constantly represented more than 70% of the revenue of this segment and almost 90% of revenue are earned through the American Government[43]. The American government is the largest military spender worldwide with almost three times the spending of China, while NASA is the space agency with the largest budget[44]. Thus, the US military spending is a good proxy for the estimation of this segment's revenue, as well as NASA's budget since Boeing is its second biggest contractor.

The projections of spending of both follow a similar trend, as well as the forecast of the segment's revenue as it is forecasted to grow at the same rate as the military budget of the American government. In 2020 and 2021 there will be a small reduction in the spending which will decrease revenue, although, from 2021 on there will be a growing trend for revenue, that is forecasted to reach $30 billion in 2027 (see exhibit 28).

- Global Services

This segment has the biggest potential of growth inside the company. Boeing's CEO predicted in 2018 that until 2027 Global Services would reach $50 billion in revenue[45]. The competitive advantage Boeing has through the knowledge of building planes for several years and the fact that most of the fleet in need of assistant was built by the company, combined with the capacity to acquire strategic players in the market such as KLX Inc. will be a major driver for the market share gain. In a market that is predicted to grow at 3.4% CAGR until 2024 and 3.7% CAGR thereafter until 2029[46], Boeing is highly outgrowing the market as its growth rate in its first year as a stand-alone business was 16.71%. Even though the forecast predicts that Boeing will continue outgrowing the market, it is not reasonable for a company to grow faster than the market forever, thus there is a convergence of the BGS's growth with the market growth rate (see exhibit 30) and

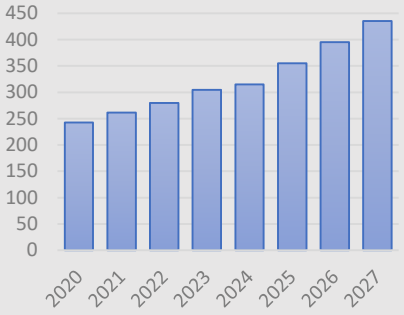
43 Boeing's Annual Report 2018
44 Statista
45 Avionics International, "As Boeing Global Services Grows, CEO Says Commercial Will Take the Lead"
46 Marsh and McLennan Companies - "Global Fleet & MRO Market Forecast Commentary" by Oliver Wyman

with this projections Boeing's market share will be 23% greater in 2027 than it was in 2019. Moreover, the estimates come short to Boeing's CEO predictions as it is forecasted that this segment's revenue will be $30.5 billion in 2027.

- Boeing Capital

Boeing Capital is not a big revenue enhancer for the company, as this segment serves clients with liquidity issues to be able to purchase Boeing's planes. The forecast of its revenue is tied to the customer's financing as it represents its portfolio of clients and is predicted to represent 10% of the value of this caption. The exhibit 31 presents the revenue forecast for this segment, showing a growing trend.

Exhibit 31: BCC revenue forecast (millions of dollars)



Source: Analyst Estimates

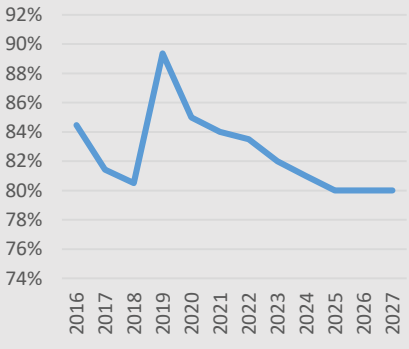
Cost of Goods Sold

The costs a company has to produce the products it sells is a major driver for its success, as it is an indicator of the operating margin of the company. Moreover, the reduced costs for each unit will lead to higher pricing power over its competitors.

Boeing has had a good performance in the last two years and the COGS reduction lead to a double figure operating margin. Despite the tendency and projections were for the increase of this effect, the 737 MAX grounding lead to a failure in these expectations. This cost's major driver is productivity and at this moment Boeing is only producing 42 737 MAX units a month instead of the 57 units projected before the grounding[47]. Due to the delay on the lift of the grounding, the production of the 737 will be halted in 2020 until the grounding is lifted, which will increase the company's problems even further.

This will highly affect the supplier and Boeing's relation with them. Spirit AeroSystems supplies the fuselage hard parts, Safran produces the wheels, brakes and seats, Senior plc produces the airframe and General Electric produces the engines. As the parts for the production of a type of airplane are only used for that model, the suppliers must adjust its production to Boeing's production. Like Boeing, the suppliers also have as a major driver the productivity, since as the production amount diminishes, the cost per unit increases, especially if a company has its production line prepared for a higher number of units than the ones actually produced. As the production costs per unit for the suppliers grow and the number of units Boeing purchases to each supplier diminishes, the bargaining power of the firms reduces, leading to an increase in unitary prices. Moreover, as Boeing's

Exhibit 32: COGS forecast (% of revenue)



Source: Analyst Estimates

47 Boeing Website

Renton factory is prepared for a 57 a month production rate, while under producing or not producing at all, the company incurs in higher costs due to the fixed costs incurred that will be spread among a fewer number of aircraft produced.

The lower production rate and its effects combined with the higher scrutiny that the production of this model is suffering from aviation authorities will lead to a higher number of flight tests and safety checks, which will increase the unitary cost of this models. Even the pre-delivery costs will increase since many of these units have been parked outside the Renton factory for months, which will consequently lead to the need of extra inspection whenever they are delivered.

Another important matter is Boeing's projections to reduce the production rate of the 787 models in 2 units a month during 2021 and 2022[48], which will lead to higher costs per unit on this aircraft family for the same reasons as the 737 family.

The COGS are forecasted to represent 85% of the revenue in 2020 and gradually decrease. This decrease is related to the increase in the production rate of the 737 MAX, that Boeing predicts to reach 57 units a month by late 2020[49], combined with the effect of the lower 787 production rate that will make the decrease in costs more gradual.

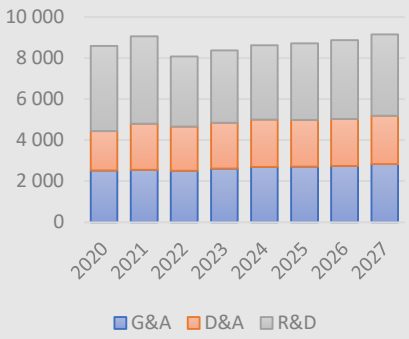
Other operating costs/income

General and administrative expense relate to certain costs that cannot be tied to one product, meaning it is related to the business as a whole instead of the manufacturing of one product. As a variable cost, this caption will follow the revenue growth and it is forecasted to represent 2,1% of the total revenue, and since this value has reflected the weight of these costs in terms of revenue in the past, it is also a good estimate for the future.

Depreciation and amortization represent the loss of value of the company's fixed assets due to the use of these assets. As the company's asset type did not have major changes, neither is predictable for this to happen, it is reasonable to assume that depreciation and amortization rates will not have major changes and D&A is forecasted to represent 16,20% of total PP&E, as this is the average value for the previous years.

Research and Development (R&D) expenses are a very important part for this business sector and even more as technologic advances have been enforcing a mindset for companies to keep innovating and reinventing the business. Moreover, in this industry this is a very important matter since Boeing operates in highly

Exhibit 33: D&A, R&D and G&A forecast (millions of dollars)



Source: Analyst Estimates

48 Boeing Website
49 Boeing Website

competitive markets, thus the importance of being able to provide a better product or service than its competitors is tremendous and that is the reason why Boeing's competitors R&D expenses have such a growing trend, especially the smaller companies trying to innovate in order to attract new customers[50]. The R&D expenses are forecasted to follow a growing tendency throughout the period, having peaks in the years of new product launches, such as the 777X, projected to be launched in 2021. Moreover, the year of 2020 will also be a year of high R&D expenses due to the costs of the 737 MAX incurred to comply with the new safety standards required after the two fatal accidents. Although in 2022 there will be a decrease in this expense, it is forecasted that afterwards there will be a growth of 3% a year.

Boeing Capital interest expense refers to the interest expense paid by the segment. Due to the lower importance this caption has on the result and the difficulty to project future debt for a separate business line, it was forecasted for the outstanding debt and its interest rate to remain constant through the projected period and according to the last information released by the company.

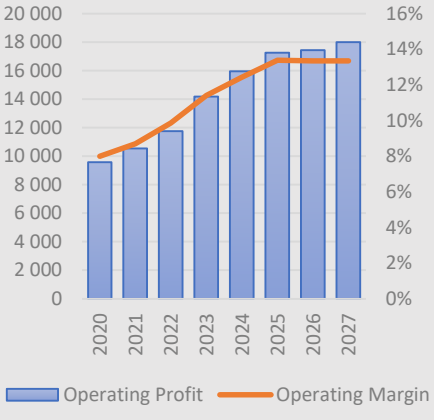
Income from operating investments represent the income from investments with a strategic purpose to the company's operations, including equity method investments, dividend income from other equity investments and the disposition of those assets. Since 2015 the return of Boeing's investments has been decreasing but it is forecasted for a gradual increase in the future as Boeing will divest from its worst performing investments and invest in more profitable ones, following a rational investment strategy. This increase will stop as the return reaches the average of the last years.

Loss/gain on dispositions of assets are considered not to have a material effect on Boeing's result and due to the difficulty of predicting which assets will be disposed and whether they will be over or undervalued this caption was estimated to represent a gain of $25 million a year.

Operating Profit

As Boeing is in a heavy manufacturing industry, it is normal to show smaller operating margins when compared to other industries. Boeing's operating profit will only return to pre-grounding values in 2024 and the effect of the higher COGS will lead to a decrease in the short-term margin. Nevertheless, this margin is forecasted to gradually increase until 2026 and onwards it will remain stable slightly over 13% (see exhibit 34).

Exhibit 34: Operating profit (billions of dollars) and Operating Margin (growth %)



Source: Analyst Estimates

50 Statista

Investment in NWC

To understand the investment in Net Working Capital, some captions must be analyzed first. Taking the operating taxes from the EBIT gives the NOPLAT which provides Boeing's operating profit after adjusting taxes. By 2027, is expected for Boeing to reach around $18 billion in operating profit.

Boeing's accounts receivable were estimated based on the average receivable days that the company has. However, this is quite different from the majority of the industry's players since Boeing is usually paid faster than its competitors. Unbilled receivables are usually generated from long-term contracts and, as said in Boeing's report, "they are intended to protect either the customer or the Company in the event that some or all the obligations under the contract are not completed". As airlines will continue to fall for bankruptcy, which are a big part of Boeing's clients, unbilled receivables are forecasted to grow at 2%. Customer financing is also expected to grow reaching its highest value of over $4 billion in 2027. Deferred income taxes are predicted to be 0.3% of the company's revenues. Moreover, with respect to the inventories, and similarly to what happens with the accounts receivable, Boeing has an inventory turnover much smaller than its competitors and the prevision for the growth in inventories is based on the historical values and the pattern that the company has regarding inventory turnover. Therefore, the inventory turnover is 1.50 from 2022, for the purposes of the research. The company will reach in 2027 almost $72 billion in inventory.

The accounts payable are computed based on an average of payable days for the company of 52 days multiplied by the operating costs. Accrued liabilities are expected to grow at 15%, since the backlog of Boeing is very big and the company's revenues will also grow. Advances and progress billings are expected to represent 37% of the revenue for each year, including the initial deposit made by a client, which is considered to be 10% of the purchasing price. Lastly, deferred income taxes are expected to represent 20% of the total operating profit.

Mostly driven by the 737 MAX grounding, the company shows a decrease in invested NWC. However, it will start to stabilize by 2021 with amounts of around $7 billion and it will reach more than $7.5 billion in 2027, which shows that the company will continue to work for operating in a more efficient manner.

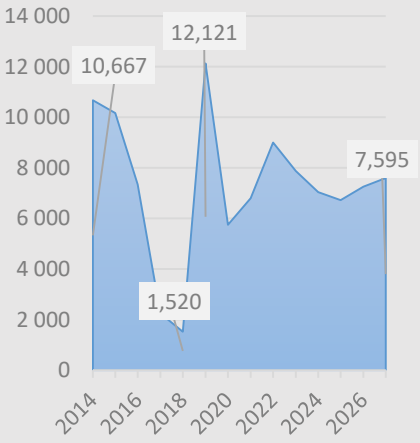
Investment in CAPEX

Investing in CAPEX helps a company to upgrade, maintain its assets and provide a better product and service to the end customer. Nevertheless, the incident of the 737 MAX leads the company to invest more in R&D, specially in 2020.

"More (airline failure) may follow as weaker players are squeezed by low-cost competition and higher fuel costs exacerbated by a strong dollar (…)".

Source: Reuters – October 4, 2019

Exhibit 35: Net Working Capital (millions of dollars)



Source: Analyst Estimates

"After a rebound on revenue, we predict strong growth in 2019 and overall expanding capital expenditures".

Source: ARC Advisory Group – May 1, 2019

Property, Plant and Equipment (PPE) include lands, buildings and land improvements, machinery and equipment and construction in progress, where machinery and equipment accounted for 49% of total PPE, in 2018. Therefore, PPE are forecasted as a percentage of BCA and BDS revenues as machinery and equipment mainly come from these two segments of the business. Property, plant and equipment will represent 14% of BCA and BDS revenues from 2021 onwards reaching more than $14.5 billion in 2027.

Goodwill can be allocated either to BGS, BCA, BDS or spread in all the different business lines of the company, which are forecasted to grow 2% every year as the company will continue acquiring strategic targets. Indeed, in 2027, goodwill is expected to be over $9.5 billion.

Acquired intangible assets principally relate "to customer and supplier relationships", as said in Boeing's annual report of 2018. Hence, acquired intangible assets are expected to have a stable growth of 2% and will account for more than $4 billion in 2027.

The net CAPEX investment reflects the expectation and rhythm at which a company grows. Thus, as it would be expected for a company in this market, the CAPEX is growing although not at a constant pace. Some fluctuations are expected in regard to the value of net CAPEX investment, mainly from 2020 to 2022, due to the recovery of the grounding. After 2022, Boeing will grow in a more constant way, having values between $2 and $3 billion. Surpassing the incidents with the 737 MAX, the company will invest over $3 billion in CAPEX by 2027.

WACC and Terminal Growth Rate

To discount the company's future cash flows, the Weighted Average Cost of Capital (WACC) was computed and the inputs needed are the cost of equity, that was computed through the Capital Asset Pricing Model (CAPM), the cost of debt, the debt to equity ratio and the US statutory tax rate.

The CAPM uses as inputs the risk-free rate, the beta of the company and the market risk premium. The risk-free rate is 1.93% and it is based on an US government 10-year bond as of the December 20th 2019[51], which was chosen due to the fact that these bonds are valued in the same currency as Boeing's cash flows. The market risk premium used is the generally accepted by common literature rate of 5.5%[52].The beta was computed through a regression between Boeing's and the S&P's returns for the last 5 years, which indicates a value of 1.14

51 Source: Bloomberg
52 Source: Mckinsey & Company Valuation "Measuring and managing the value of companies", 4th edition

Exhibit 36: Computed CAPM and Confidence Interval

Start Date	01/10/2014
End Date	30/09/2019
# days in sample	1304
Beta	1.1413
Standar Error	0.0394
95% Condidence Interval	
Lower Limit	1.0641
Upper Limit	1.2184

Source: Analyst Estimates

Exhibit 37: Computed WACC and Terminal Growth Rate

Risk-Free Rate	1.93%
Market Risk Premium	5.50%
Levered Beta	1.14
Cost of Equity	8.21%
Cost of Debt	2.70%
Probability of Default	0.18%
Loss given Default	46.15%
YTM	2.78%
Market Value of Debt	21,974
Cash and Equivalents	8,475
Net Debt	13,500
Market Cap	183,335
Debt to Equity	7.36%
US Statutory Tax Rate	21.00%
Terminal Growth Rate	2.95%
WACC	**7.79%**

Source: Analyst Estimates

(see exhibit 36). This was done due to unreasonable results from the beta of the comparable companies, which would underestimate Boeing's risk, since most of them have a much lower productive capacity installed, that in Boeing's case is related to commercial airplanes, and thus lower fixed costs. With all the assumptions in place we reach a cost of equity of 8.21%.

Regarding the cost of debt, the inputs used were the yield to maturity (YTM), the probability of default and the loss given default. The YTM is 2.78% and is computed with the weighted average of the yields of each bond, while the probability of default is 0,18% and was computed by annualizing the default rate of A rated bonds with maturity of 13 years[53], which is the average maturity of Boeing's bonds, and the loss given default is 46.15%, representing the opposite of the recovery rate of 53.85%[54]. Combining the assumptions, the cost of debt is 2.70%.

For the debt to equity ratio it was assumed that the ratio will keep stable in the future, thus the current ratio was used for the WACC calculations. This ratio is around 7.36% for the company at the moment, which is lower than most of its competitors. We concluded that this ratio is suitable for the company, since Airbus has a similar ratio and as this is the comparable that has the most similar characteristics to Boeing.

The US statutory tax rate is currently 21% and it was assumed that this rate will continue to be used.

Using all these assumptions and the formula for the WACC we get a value of 7.79%, as it can be seen in exhibit 37.

Regarding the terminal growth rate, it was computed by multiplying the return on invested capital (ROIC) and the reinvestment rate (RR) in the year of 2027 since this was considered to be a year when the growth rate of the company is already stable. The ROIC in this year is 42.09% and the RR is 7.01%, resulting in a terminal growth rate of 2.95%. While comparing the ROIC to the WACC, it is possible to understand that the company's invested capital has a high performance as there is a 35% positive spread for the ROIC.

Valuation Outcomes

Our model indicates an Enterprise Value of $239,248 million, that subtracted from the net debt reaches an equity value of $225,748 million equivalent to a target price

53 Source: S&P 2018 Annual Global Corporate Default and Rating Transition Study
54 Source: Moody's Default Study, 2018

of $401.12 per share. This represents an upside of 23.13% to the current stock price.

- Multiple Valuation

To understand how the market is perceiving Boeing's enterprise value and equity, two EV multiples and one equity multiple were used. The median value for all the peers and for the biggest companies were used to perform the multiple valuation, as this metric excludes outliers in the sample (see exhibit 38). Regarding the EV, it is possible to understand that the company is overvalued when using the EBITDA but undervalued when using the EBIT, which happens due to the higher depreciation and amortization Boeing has when compared to its peers. Regarding the equity, in line with the EBIT, we conclude the company is undervalued comparing to its peers. This can be explained by the recent events of the 737 MAX grounding that resulted in a big drop in share price, and thus EV, for the company.

Exhibit 38: Multiple Valuation

MULTIPLE VALUATION			
	EV/EBITDA	**EV/EBIT**	**P/E**
Boeing	11.7	13.6	17.4
Lockheed Martin	12.8	14.7	18.6
Airbus SE	8.4	12.6	24.7
General Dynamics	11.5	14.7	16.2
Raytheon Co	10.6	12.2	18.0
Northrop Grumman	15.2	20.9	16.0
BAE Systems PLC	8.3	10.7	13.7
Textron	8.1	11.1	14.2
Thales SA	10.0	14.0	20.7
Embraer	16.4	64.7	30.2
Bombardier inc	9.0	15.0	47.9
Finmeccanica	5.5	9.4	10.9
Top 6 Average	11.6	14.2	17.7
	1.17%	-3.73%	-1.72%
Total Average	10.3	13.8	17.7
	13.63%	-1.29%	-1.72%

Source: Bloomberg, Analyst Estimates

Sensitivity Analysis

In this section, a sensitivity analysis is performed. This will test some of the most relevant inputs of the model and the impact that its uncertainty may have to Boeing's share price. Firstly, we will test the sensitivity of the WACC and the terminal growth rate (g) as these are the inputs in which smaller changes lead to higher changes in the price per share. The WACC's uncertainty is tied to the beta of the company as the beta was computed through a regression with a 95% confidence interval of [1.0641;1.2184], thus the test will range between the correspondent WACC's using each of the betas in the interval limits. Regarding the terminal growth rate, it is important to understand the changes that different

Exhibit 39: Sensitivity Analysis of Boeing

		WACC				
		7.40%	7.59%	7.79%	7.99%	8.19%
g	2.6%	411	393	377	362	348
	2.8%	425	406	389	373	358
	3.0%	440	420	401	384	368
	3.2%	457	435	415	396	380
	3.4%	475	451	430	410	392

Source: Analyst Estimates

Exhibit 40: Sensitivity Analysis of Boeing

Narrow Body Market Share				
-10%	-5%	Base	+5%	+10%
372	386	401	416	430

Source: Analyst Estimates

values will cause to the share price, since this input is difficult to be certain about, as it implies the growth rate for several years. The outcome of the analysis is a price range between 348 and 475, confirming that these inputs have a strong effect on the share price. Nevertheless, there are only two cases that will change the recommendation to hold (see exhibit 39).

Another matter that leads to some level of uncertainty is the timing of the 737 MAX return to service and the degree of acceptance of the airplane by the airlines. Even though this analysis does not predict Boeing's response to either of the cases and only focuses on the effect the market share has on revenue, it is a good indicator as the magnitude of the results show the importance of the return of the 737 to service. Moreover, in exhibit 40 it is possible to understand that a constant loss of 10% market share will lead to a decrease in share price of around $29 and the increase of 10% will lead to the same magnitude of share price change.

Key Risks and Challenges

In this section, the main obstacles that Boeing will face in the future will be analysed. In the beginning of March 2019, Boeing's stock price and perspective of growth were the highest ever due to the new 737 MAX that would revolutionize aviation. Shortly after, the second accident happened, which resulted in the grounding and lead to a downturn for Boeing, and consequently to one of the worst years in the company's history. Thus, the main challenge Boeing is facing is the lift of the grounding from the aviation authorities that has been delayed several times this year. Even after this lift, there is an important challenge for the company, which is for this airplane to be accepted as safe and to gain the passengers' confidence again. Regarding the most important risks, they are also tied to the 737 MAX and are related to the loss of trust in the company from airlines, especially those who are more dependent on the 737, such as Southwest Airlines, that in the future may look into a more diversified fleet and place orders for Airbus.

Appendix

Financial Statements

Income Statement																		
Dollars in millions	2014	2015	2016	2017	2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2019	2020	2021	2022	2023	2024	2025	2026	2027
Commercial Airplanes (BCA)	59 990	59 399	59 378	58 014	60 715	11 822	4 722	8 249	9 400	34 193	73 653	71 936	68 096	71 476	73 661	71 944	71 615	73 881
Defense, Space & Security (BDS)	21 413	23 708	20 180	20 561	23 195	6 611	6 612	7 042	6 755	27 020	26 792	26 532	27 142	27 468	27 875	28 729	29 421	30 113
Global Services (BGS)	9 468	13 293	13 819	14 581	17 018	4 619	4 543	4 658	4 963	18 783	20 379	21 973	23 542	25 063	26 511	27 983	29 329	30 522
Boeing Capital (BCC)	416	413	298	307	274	66	75	66	68	275	243	262	280	305	315	355	395	435
Unallocated items, eliminations and others	-525	-699	-179	542	-75	-201	-201	-35	-35	-472	0	0	0	0	0	0	0	0
Operating Revenues	**90 762**	**96 114**	**93 496**	**94 005**	**101 127**	**22 917**	**15 751**	**19 980**	**21 150**	**79 798**	**121 067**	**120 702**	**119 060**	**124 311**	**128 362**	**129 011**	**130 760**	**134 951**
Growth Rate	*n.a*	*5,90%*	*-2,72%*	*0,54%*	*7,58%*	*-9,35%*	*-31,27%*	*26,85%*	*5,86%*	*-21,09%*	*51,72%*	*-0,30%*	*-1,36%*	*4,41%*	*3,26%*	*0,51%*	*1,36%*	*3,21%*
Cost of Goods Sold	**-76 683**	**-82 024**	**-78 967**	**-76 542**	**-81 421**	**-18 627**	**-17 794**	**-16 915**	**-17 978**	**-71 314**	**-102 907**	**-101 390**	**-99 415**	**-101 935**	**-103 973**	**-103 209**	**-104 608**	**-107 960**
% of Revenue	*84,49%*	*85,34%*	*84,46%*	*81,42%*	*80,51%*	*81,28%*	*112,97%*	*84,66%*	*85,00%*	*89,37%*	*85,00%*	*84,00%*	*83,50%*	*82,00%*	*81,00%*	*80,00%*	*80,00%*	*80,00%*
General and administrative expense, excluding D&A	**-1 861**	**-1 692**	**-1 724**	**-2 048**	**-2 453**	**-663**	**-126**	**-425**	**-423**	**-1 637**	**-2 542**	**-2 535**	**-2 500**	**-2 611**	**-2 696**	**-2 709**	**-2 746**	**-2 834**
% of Revenue	*2,05%*	*1,76%*	*1,84%*	*2,18%*	*2,43%*	*2,89%*	*0,80%*	*2,13%*	*2,00%*	*2,05%*	*2,10%*	*2,10%*	*2,10%*	*2,10%*	*2,10%*	*2,10%*	*2,10%*	*2,10%*
Depreciation and Amortization	**-1 906**	**-1 833**	**-1 889**	**-2 047**	**-2 114**	**-521**	**-546**	**-576**	**-563**	**-2 206**	**-1 952**	**-2 233**	**-2 160**	**-2 244**	**-2 302**	**-2 283**	**-2 291**	**-2 358**
% of PP&E	*17,32%*	*15,18%*	*14,75%*	*16,15%*	*16,72%*	*16,55%*	*17,33%*	*18,39%*	*17,42%*	*17,07%*	*16,20%*	*16,20%*	*16,20%*	*16,20%*	*16,20%*	*16,20%*	*16,20%*	*16,20%*
Research and development expense	**-3 047**	**-3 331**	**-4 626**	**-3 179**	**-3 269**	**-866**	**-826**	**-778**	**-846**	**-3 316**	**-4 145**	**-4 269**	**-3 415**	**-3 518**	**-3 623**	**-3 732**	**-3 844**	**-3 959**
Growth Rate	*n.a.*	*9,32%*	*38,88%*	*-31,28%*	*2,83%*	*5,97%*	*-4,62%*	*-5,81%*	*4,00%*	*4,16%*	*25,00%*	*3,00%*	*-20,00%*	*3,00%*	*3,00%*	*3,00%*	*3,00%*	*3,00%*
Boeing Capital interest expense	**-69**	**-64**	**-59**	**-70**	**-69**	**-18**	**-16**	**-15**	**-15**	**-64**	**-60**	**-60**	**-60**	**-60**	**-60**	**-60**	**-60**	**-60**
BCC Outstanding Debt	2 412	2 355	2 864	2 523	2 487	2 066	1 891	1 891	1 891	1 891	1 891	1 891	1 891	1 891	1 891	1 891	1 891	1 891
	-2,86%	*-2,72%*	*-2,06%*	*-2,77%*	*-2,77%*	*-3,48%*	*-3,38%*	*-3,17%*	*-3,17%*	*-3,17%*	*-3,17%*	*-3,17%*	*-3,17%*	*-3,17%*	*-3,17%*	*-3,17%*	*-3,17%*	*-3,17%*
Income from operating investments, net	**287**	**274**	**303**	**204**	**111**	**20**	**-15**	**-8**	**-3**	**-6**	**54**	**91**	**125**	**168**	**195**	**196**	**199**	**205**
% of investments	*11,42%*	*13,47%*	*11,91%*	*8,36%*	*5,51%*	*3,85%*	*-3,80%*	*-1,41%*	*-0,45%*	*-0,24%*	*3,00%*	*5,00%*	*7,00%*	*9,00%*	*10,13%*	*10,13%*	*10,13%*	*10,13%*
Loss/Gain on dispositions, net	**-10**	**-1**	**-7**	**21**	**75**	**108**	**192**	**-4**	**-40**	**256**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
Operating Costs	**-83 289**	**-88 671**	**-86 969**	**-83 661**	**-89 140**	**-20 567**	**-19 131**	**-18 721**	**-19 868**	**-78 287**	**-111 527**	**-110 371**	**-107 400**	**-110 175**	**-112 435**	**-111 772**	**-113 325**	**-116 942**
% of Revenue	*91,77%*	*92,26%*	*93,02%*	*89,00%*	*88,15%*	*89,75%*	*121,46%*	*93,70%*	*93,93%*	*98,11%*	*92,12%*	*91,44%*	*90,21%*	*88,63%*	*87,59%*	*86,64%*	*86,67%*	*86,66%*
Operating Profit	**7 473**	**7 443**	**6 527**	**10 344**	**11 987**	**2 350**	**-3 380**	**1 259**	**1 283**	**1 512**	**9 540**	**10 331**	**11 659**	**14 137**	**15 927**	**17 239**	**17 434**	**18 009**
% of Revenue	*8,23%*	*7,74%*	*6,98%*	*11,00%*	*11,85%*	*10,25%*	*-21,46%*	*6,30%*	*6,07%*	*1,89%*	*7,88%*	*8,56%*	*9,79%*	*11,37%*	*12,41%*	*13,36%*	*13,33%*	*13,34%*
Adjusted Taxes	-1807	-2071	-703	-1818	-1263	-232	430	-78	-446	-326	-1476	-1646	-1998	-2547	-2877	-3146	-3185	-3305
NOPLAT	**5 667**	**5 372**	**5 824**	**8 526**	**10 724**	**2 118**	**-2 950**	**1 181**	**837**	**1 186**	**8 064**	**8 685**	**9 662**	**11 590**	**13 050**	**14 093**	**14 249**	**14 703**
Currency translation adjustments	-97	-92	-104	128	-86	1	-3	-59	-20	-81	-81	-81	-81	-81	-81	-81	-81	-81
Unrealized gain/(loss) on certain investments, net of tax	0	8	-2	1	2	1	0	0	0	1	1	1	1	1	1	1	1	1
Unrealized gains on derivative instruments, net of tax	-130	-61	70	171	-116	9	-29	-64	-28	-112	-112	-112	-112	-112	-112	-112	-112	-112
Defined benefit pension plans & other postretirement benefits, net of tax	-3 782	1 300	-839	-53	1 490	103	93	104	100	400	400	400	400	400	400	400	400	400
Comprehensive loss related to noncontrolling interests	10	-3	-1	-2	-21	0	-7	-15	-7	-29	-29	-29	-29	-29	-29	-29	-29	-29
Other income/(loss), net	-3	-13	-438	123	92	106	107	121	111	445	445	445	445	445	445	445	445	445
Taxes	-1	-5	-153	43	19	22	22	25	23	94	94	94	94	94	94	94	94	94
Non Core Result	**-4 003**	**1 134**	**-1 467**	**411**	**1 380**	**242**	**183**	**112**	**179**	**718**	**718**	**718**	**718**	**718**	**718**	**718**	**718**	**718**
Interest and debt expense	-333	-275	-306	-360	-475	-123	-154	-203	-254	-734	1 015	942	897	859	809	769	716	651
% of (t-1) Long term debt	*n.a.*	*-3,38%*	*-3,51%*	*-3,76%*	*-4,86%*	*-4,62%*	*-5,42%*	*-5,46%*	*-5,00%*	*-14,46%*	*5,00%*	*5,00%*	*5,00%*	*5,00%*	*5,00%*	*5,00%*	*5,00%*	*5,00%*
Tax Shield	117	96	107	126	100	26	32	43	53	154	-213	-198	-188	-180	-170	-161	-150	-137
Net financing income	**-216**	**-179**	**-199**	**-234**	**-375**	**-97**	**-122**	**-160**	**-200**	**-580**	**802**	**744**	**709**	**678**	**639**	**607**	**566**	**514**
Total Comprehensive Income	**1 447**	**6 328**	**4 158**	**8 703**	**11 729**	**2 263**	**-2 888**	**1 133**	**816**	**1 324**	**9 583**	**10 147**	**11 088**	**12 986**	**14 407**	**15 418**	**15 532**	**15 935**

Balance Sheet																	
Dollars in millions	2014	2015	2016	2017	2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2019	2020	2021	2022	2023	2024	2025	2026	2027
Core Business																		
Operating Assets																		
Operational Cash	1 815	1 922	1 870	1 880	2 023	458	315	400	423	1 596	2 421	2 414	2 381	2 486	2 567	2 580	2 615	2 699
% of revenue	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*
Accounts receivable, net	7 729	8 713	8 832	2 894	3 879	3 669	3 291	3 564	3 859	3 859	4 644	4 630	4 567	4 768	4 923	4 948	5 015	5 176
Average receivable days	*31*	*33*	*34*	*11*	*14*	*14*	*19*	*16*	*16*	*18*	*14*	*14*	*14*	*14*	*14*	*14*	*14*	*14*
Unbilled receivables, net	0	0	0	8 194	10 025	10 208	10 247	11 078	11 459	11 459	11 688	11 922	12 160	12 404	12 652	12 905	13 163	13 426
Growth rate	*n.a.*	*0,0%*	*0,0%*	*0,0%*	*22,3%*	*1,8%*	*0,4%*	*8,1%*	*3,4%*	*14,3%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*
Long-term contracts in progress (as % of unbilled receivables)	*n.a.*	*n.a.*	*n.a.*	*23%*	*21%*	*11%*	*8%*	*9%*	*9,5%*	*9,5%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*
Customer financing, net	3 561	3 570	4 201	3 065	2 878	2 576	2 310	2 243	2 300	2 300	2 425	2 615	2 800	3 046	3 152	3 552	3 952	4 352
New Costumer financing		*797*	*1533*	*-159*	*300*					*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*
Deferred Income Tax	317	265	332	321	284	281	357	296	254	254	363	362	357	373	385	387	392	405
% of revenue	*0,3%*	*0,3%*	*0,4%*	*0,3%*	*0,3%*	*0,3%*	*0,6%*	*0,4%*	*0,3%*	*0,3%*	*0,3%*	*0,3%*	*0,3%*	*0,3%*	*0,3%*	*0,3%*	*0,3%*	*0,3%*
Inventories	46 756	47 257	43 199	61 388	62 567	65 369	68 492	73 279	83 794	83 794	64 317	65 413	66 277	67 957	69 315	68 806	69 739	71 974
Inventory Turnover	*1,64*	*1,74*	*1,83*	*1,25*	*1,30*	*1,14*	*1,04*	*0,92*	*0,81*	*0,81*	*1,60*	*1,55*	*1,50*	*1,50*	*1,50*	*1,50*	*1,50*	*1,50*
Property, plant and equipment, net	11 007	12 076	12 807	12 672	12 645	12 594	12 601	12 527	12 924	12 924	12 053	13 785	13 333	13 852	14 215	14 094	14 145	14 559
Revenue BCA	*59 990*	*59 399*	*59 378*	*58 014*	*60 715*	*11 822*	*4 722*	*8 249*	*9 400*	*34 193*	*73 653*	*71 936*	*68 096*	*71 476*	*73 661*	*71 944*	*71 615*	*73 881*
Revenue BDS	*21 413*	*23 708*	*20 180*	*20 561*	*23 195*	*6 611*	*6 612*	*7 042*	*6 755*	*27 020*	*26 792*	*26 532*	*27 142*	*27 468*	*27 875*	*28 729*	*29 421*	*30 113*
Property, plant and equipment, as % of revenues BCA & BDS	*14%*	*15%*	*16%*	*16%*	*15%*	*17%*	*28%*	*20%*	*20%*	*21%*	*12%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*
Goodwill	5 119	5 126	5 324	5 559	7 840	7 967	8 051	8 063	8 139	8 139	8 302	8 468	8 637	8 810	8 986	9 166	9 349	9 536
Growth rate	*n.a.*	*0,14%*	*3,86%*	*4,41%*	*41,03%*	*1,62%*	*1,05%*	*0,15%*	*0,94%*	*3,81%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*	*2,0%*
Acquired intangible assets, net	2 869	2 657	2 540	2 573	3 429	3 498	3 761	3 587	3 646	3 646	3 719	3 793	3 869	3 946	4 025	4 106	4 188	4 271
Growth rate	*n.a.*	*-7,39%*	*-4,40%*	*1,30%*	*33,27%*	*2,01%*	*7,52%*	*-4,63%*	*1,63%*	*6,32%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*	*2,00%*
Total Operating Assets	**79 173**	**81 586**	**79 105**	**98 546**	**105 570**	**106 620**	**109 425**	**115 037**	**126 798**	**127 971**	**109 932**	**113 402**	**114 381**	**117 642**	**120 221**	**120 543**	**122 558**	**126 398**
Operating Liabilities																		
Accounts payable	10 667	10 800	11 190	12 202	12 916	14 693	15 267	15 101	16 556	16 556	15 278	15 724	15 301	15 696	16 018	15 924	16 145	16 660
Average payable days	*51*	*48*	*52*	*58*	*58*	*71*	*77*	*80*	*75*	*85*	*50*	*52*	*52*	*52*	*52*	*52*	*52*	*52*
Accrued liabilities	13 462	14 014	14 691	13 069	14 808	13 007	20 042	19 224	20 304	20 304	18 160	18 105	17 859	18 647	19 254	19 352	19 614	20 243
% of revenues	*14,8%*	*14,6%*	*15,7%*	*13,9%*	*14,6%*	*14,2%*	*31,8%*	*24,1%*	*24,0%*	*25,4%*	*15,0%*	*15,0%*	*15,0%*	*15,0%*	*15,0%*	*15,0%*	*15,0%*	*15,0%*
Advances and progress billings	23 175	24 364	23 869	48 042	50 676	52 534	52 523	53 167	52 741	52 741	44 795	44 660	44 052	45 995	47 494	47 734	48 381	49 932
% of revenues	*25,53%*	*25,35%*	*25,53%*	*51,11%*	*50,11%*	*65,83%*	*65,82%*	*66,63%*	*66,09%*	*66,09%*	*37,0%*	*37,0%*	*37,0%*	*37,0%*	*37,0%*	*37,0%*	*37,0%*	*37,0%*
Deferred income taxes	2 207	2 392	1 338	2 188	1 736	1 656	0	1 615	1 539	1 539	1 908	2 066	2 332	2 827	3 185	3 448	3 487	3 602
% of operating profit	*29,53%*	*32,14%*	*20,50%*	*21,15%*	*14,48%*	*17,62%*	*0,00%*	*32,07%*	*30,00%*	*101,82%*	*20,00%*	*20,00%*	*20,00%*	*20,00%*	*20,00%*	*20,00%*	*20,00%*	*20,00%*
Total Operating Liabilities	**49 511**	**51 570**	**51 088**	**75 501**	**80 136**	**81 890**	**87 832**	**89 107**	**91 141**	**91 141**	**80 140**	**80 555**	**79 544**	**83 165**	**85 952**	**86 457**	**87 627**	**90 436**
Invested Capital - Core Business (NOA - Net Operating Assets)	**29 662**	**30 016**	**28 017**	**23 045**	**25 434**	**24 730**	**21 593**	**25 930**	**35 657**	**36 829**	**29 791**	**32 846**	**34 837**	**34 476**	**34 269**	**34 086**	**34 931**	**35 962**
Δ of Invested Capital (Core Business)		*1,18%*	*-7,14%*	*-21,57%*	*9,39%*	*-2,84%*	*-14,53%*	*16,72%*	*27,28%*	*3,18%*	*-23,62%*	*9,30%*	*5,72%*	*-1,05%*	*-0,60%*	*-0,54%*	*2,42%*	*2,87%*
Non Core Business																		
Non-Operating Assets																		
Other assets, net of accumulated amortization	1 317	1 408	1 416	4 444	4 161	5 135	6 403	5 931	6 688	6 688	5 497	5 103	4 575	4 706	4 809	4 822	4 902	5 056
% of operating assets	*1,66%*	*1,73%*	*1,79%*	*4,51%*	*3,94%*	*4,82%*	*5,85%*	*5,16%*	*5,27%*	*5,23%*	*5,00%*	*4,50%*	*4,00%*	*4,00%*	*4,00%*	*4,00%*	*4,00%*	*4,00%*
Total Non-Operating Assets	**1 317**	**1 408**	**1 416**	**4 444**	**4 161**	**5 135**	**6 403**	**5 931**	**6 688**	**6 688**	**5 497**	**5 103**	**4 575**	**4 706**	**4 809**	**4 822**	**4 902**	**5 056**
Non-Operating Liabilities																		
Other long-term liabilities	1 566	2 078	2 221	2 015	3 059	3 731	4 839	3 621	3 646	3 646	2 942	2 957	2 920	3 053	3 155	3 174	3 217	3 320
% of operating liabilities	*3,16%*	*4,03%*	*4,35%*	*2,67%*	*3,82%*	*4,56%*	*5,51%*	*4,06%*	*4,00%*	*4,00%*	*3,67%*	*3,67%*	*3,67%*	*3,67%*	*3,67%*	*3,67%*	*3,67%*	*3,67%*
Pension Plan Liability	17 182	17 783	19 943	16 471	15 323	15 077	14 831	14 590	14 833	14 833	14 684	14 537	14 392	14 248	14 106	13 965	13 825	13 687
Growth Rate	*n.a.*	*3,50%*	*12,15%*	*-17,41%*	*-6,97%*	*-1,61%*	*-1,63%*	*-1,62%*	*1,66%*	*-3,20%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*
Retiree Health Care Liability	6 802	6 616	5 916	5 545	4 584	4 535	4 486	4 437	4 486	4 486	4 441	4 397	4 353	4 309	4 266	4 223	4 181	4 139
Growth Rate	*n.a.*	*-2,73%*	*-10,58%*	*-6,27%*	*-17,33%*	*-1,07%*	*-1,08%*	*-1,09%*	*1,10%*	*-2,14%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*	*-1,00%*
Total Non-Operating Liabilities	**25 550**	**26 477**	**28 080**	**24 031**	**22 966**	**23 343**	**24 156**	**22 648**	**22 964**	**22 964**	**22 067**	**21 891**	**21 665**	**21 610**	**21 527**	**21 362**	**21 223**	**21 146**
Invested Capital - Non Core Business	**-24 233**	**-25 069**	**-26 664**	**-19 587**	**-18 805**	**-18 208**	**-17 753**	**-16 717**	**-16 276**	**-16 276**	**-16 571**	**-16 788**	**-17 090**	**-16 905**	**-16 718**	**-16 540**	**-16 321**	**-16 090**
Δ of Invested Capital (Non Core Business)		*3,33%*	*5,98%*	*-36,13%*	*-4,16%*	*-3,28%*	*-2,56%*	*-6,20%*	*-2,71%*	*0,00%*	*1,78%*	*1,30%*	*1,76%*	*-1,09%*	*-1,12%*	*-1,08%*	*-1,34%*	*-1,43%*
Financial Assets																		
Excess Cash	9 918	9 380	6 931	6 933	5 614	6 378	8 852	9 363	7 980	7 980	6 053	6 035	5 953	6 216	6 418	6 451	6 538	6 748
% of revenues	*10,93%*	*9,76%*	*7,41%*	*7,38%*	*5,55%*	*6,96%*	*14,05%*	*11,72%*	*9,43%*	*10%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*
Investments	2 513	2 034	2 545	2 439	2 014	2 076	1 581	2 267	2 394	2 394	1 816	1 811	1 786	1 865	1 925	1 935	1 961	2 024
	25,34%	*21,69%*	*36,72%*	*35,18%*	*35,87%*	*32,55%*	*17,86%*	*24,21%*	*30,00%*	*30,00%*	*30,00%*	*30,00%*	*30,00%*	*30,00%*	*30,00%*	*30,00%*	*30,00%*	*30,00%*
Total Financial Assets	**12 431**	**11 414**	**9 476**	**9 372**	**7 628**	**8 454**	**10 433**	**11 630**	**10 374**	**10 374**	**7 869**	**7 846**	**7 739**	**8 080**	**8 344**	**8 386**	**8 499**	**8 772**
Δ of Financial Assets		*-8,91%*	*-20,45%*	*-1,11%*	*-22,85%*	*9,76%*	*18,97%*	*10,30%*	*-12,11%*	*0,00%*	*-31,83%*	*-0,30%*	*-1,38%*	*4,22%*	*3,16%*	*0,50%*	*1,34%*	*3,11%*
Financial Liabilities																		
Short-term debt and current portion of long-term debt	929	1 234	384	1 335	3 190	3 381	4 357	4 354	2 854	2 854	3 204	2 654	2 529	2 754	2 554	2 804	3 054	2 454
Long-term debt	8 141	8 730	9 568	9 782	10 657	11 363	14 859	20 298	20 298	20 298	18 848	17 948	17 173	16 173	15 373	14 323	13 023	12 323
Total Financial Liabilities	**9 070**	**9 964**	**9 952**	**11 117**	**13 847**	**14 744**	**19 216**	**24 652**	**23 152**	**23 152**	**22 052**	**20 602**	**19 702**	**18 927**	**17 927**	**17 127**	**16 077**	**14 777**
Δ of Financial Liabilities		*8,97%*	*-0,12%*	*10,48%*	*19,72%*	*6,08%*	*23,27%*	*22,05%*	*-6,48%*	*0,00%*	*-4,99%*	*-7,04%*	*-4,57%*	*-4,09%*	*-5,58%*	*-4,67%*	*-6,53%*	*-8,80%*
Net Financial Assets	**3 361**	**1 450**	**-476**	**-1 745**	**-6 219**	**-6 290**	**-8 783**	**-13 022**	**-12 778**	**-12 778**	**-14 183**	**-12 756**	**-11 963**	**-10 847**	**-9 584**	**-8 742**	**-7 578**	**-6 006**
Total Shareholders' Equity	8 665	6 335	817	1 656	339	125	-5 322	-4 116	6 602	7 775	-962	3 301	5 785	6 725	7 967	8 805	11 032	13 866
Noncontrolling interests	125	62	60	57	71	107	379	307										
Total Shareholders' Equity	**8 790**	**6 397**	**877**	**1 713**	**410**	**232**	**-4 943**	**-3 809**	**6 602**	**7 775**	**-962**	**3 301**	**5 785**	**6 725**	**7 967**	**8 805**	**11 032**	**13 866**

Cash Flow Statement																		
Dollars in millions	2014	2015	2016	2017	2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2019	2020	2021	2022	2023	2024	2025	2026	2027
EBIT	7 473	7 443	6 527	10 344	11 987	2 350	-3 380	1 259	1 283	1 512	9 540	10 331	11 659	14 137	15 927	17 239	17 434	18 009
Taxes	-2 616	-2 605	-2 284	-3 620	-2 517	-494	710	-264	-269	-317	-2 003	-2 169	-2 448	-2 969	-3 345	-3 620	-3 661	-3 782
Foreign derived intangible income	0	0	0	0	-545					0	0	0	0	0	0	0	0	0
Federal audit settlements	-257	0	-179	0	-418					456	0	0	0	0	0	0	0	0
Research and development credits	-207	-243	-289	-162	-209					-211	-260	-259	-206	-219	-225	-230	-236	-244
% of R&D	*6,79%*	*7,30%*	*6,25%*	*5,09%*	*6,39%*					*6,36%*	*6,28%*	*6,07%*	*6,04%*	*6,23%*	*6,20%*	*6,16%*	*6,14%*	*6,15%*
Excess tax benefits	0	0	-104	-212	-186					-100	-120	-145	-153	-141	-132	-138	-142	-141
Other provision adjustments	14	-29	-17	-20	151					20	21	31	40	53	33	36	38	40
Impact of Tax Cuts and Jobs Act	0	0	0	-1 273	-116					0	0	0	0	0	0	0	0	1
Tax on non-US activities	-14	-43	-29	-91	35					-28	-31	-29	-29	-17	-27	-27	-26	-25
Tax basis adjustment	-257	0	-440	0	0					0	0	0	0	0	0	0	0	1
U.S. manufacturing activity tax benefit	-86	-207	-214	-131	0					-128	-136	-122	-103	-98	-117	-115	-111	-109
Adjustments to Taxes	-806	-522	-1 272	-1 890	-1 288	-261	280	-186	176	8	-527	-524	-451	-422	-468	-474	-476	-477
Operating Taxes	-1 807	-2 071	-703	-1 818	-1 263	-232	430	-78	-446	-326	-1 476	-1 646	-1 998	-2 547	-2 877	-3 146	-3 185	-3 305
NOPLAT	5 667	5 372	5 824	8 526	10 724	2 118	-2 950	1 181	837	1 186	8 064	8 685	9 662	11 590	13 050	14 093	14 249	14 703
Depreciation and Amortization	1 906	1 833	1 889	2 047	2 114	521	546	576	563	2 206	1 952	2 233	2 160	2 244	2 302	2 283	2 291	2 358
Operating cash flow	**7 573**	**7 205**	**7 713**	**10 573**	**12 838**	**2 639**	**-2 404**	**1 757**	**1 400**	**3 392**	**10 016**	**10 918**	**11 822**	**13 833**	**15 353**	**16 376**	**16 540**	**17 062**
Invested Capital - Fixed Assets	18 995	19 859	20 671	20 804	23 914	24 059	24 413	24 177	24 709	24 709	24 074	26 046	25 839	26 608	27 226	27 365	27 682	28 366
Gross Capex Investment		-864	-812	-133	-3 110	-145	-354	236	-532	0	635	-1 973	207	-769	-618	-139	-316	-685
Net Capex Investment		-2 697	-2 701	-2 180	-5 224	-666	-900	-340	-1 094	-2 206	-1 317	-4 205	-1 953	-3 013	-2 920	-2 422	-2 607	-3 043
Invested Capital - Net Working Capital	10 667	10 157	7 346	2 241	1 520	671	-2 820	1 753	10 948	12 121	5 718	6 800	8 998	7 868	7 043	6 721	7 249	7 595
Investment in NWC		510	2 811	5 105	722	848	3 491	-4 573	-9 195	-1 173	6 403	-1 082	-2 198	1 130	825	322	-528	-346
Investment Cash Flow	**0**	**-2 187**	**110**	**2 925**	**-4 502**	**182**	**2 591**	**-4 913**	**-10 290**	**-3 379**	**5 086**	**-5 288**	**-4 151**	**-1 883**	**-2 095**	**-2 100**	**-3 136**	**-3 389**
Free Cash Flow Core Business	**7 573**	**5 018**	**7 824**	**13 498**	**8 335**	**2 821**	**188**	**-3 156**	**-8 890**	**13**	**15 102**	**5 630**	**7 671**	**11 951**	**13 258**	**14 276**	**13 405**	**13 672**
Non-Operating Cash Flow	-4 003	1 134	-1 467	411	1 380	242	183	112	179	718	718	718	718	718	718	718	718	718
Invested Capital	-24 233	-25 069	-26 664	-19 587	-18 805	-18 208	-17 753	-16 717	-16 276	-16 276	-16 571	-16 788	-17 090	-16 905	-16 718	-16 540	-16 321	-16 090
Change in Invested Capital		836	1 595	-7 077	-782	-597	-455	-1 036	-441	0	294	217	301	-185	-186	-178	-220	-231
Free Cash Flow Non Core Business	**-4 003**	**1 970**	**128**	**-6 666**	**598**	**-355**	**-272**	**-924**	**-261**	**718**	**1 012**	**935**	**1 019**	**533**	**531**	**539**	**498**	**487**
Free Cash Flow	**3 569**	**6 989**	**7 951**	**6 832**	**8 934**	**2 466**	**-84**	**-4 079**	**-9 151**	**731**	**16 114**	**6 565**	**8 690**	**12 483**	**13 789**	**14 815**	**13 903**	**14 159**
Financing Cash Flow																		
Net financing income	-216	-179	-199	-234	-375	-97	-122	-160	-200	-580	802	744	709	678	639	607	566	514
Change in financial assets		1 911	1 926	1 269	4 473	72	2 493	4 239	-243	0	1 404	-1 426	-793	-1 116	-1 263	-842	-1 164	-1 572
Change in equity		-2 393	-5 520	836	-1 303	-178	-5 175	1 134	10 411	1 173	-8 737	4 264	2 483	940	1 242	837	2 228	2 834
Total Comprehesive Income	1 447	6 328	4 158	8 703	11 729	2 263	-2 888	1 133	816	1 324	9 583	10 147	11 088	12 986	14 407	15 418	15 532	15 935
Financing Cash Flow		**-6 989**	**-7 951**	**-6 832**	**-8 934**	**-2 466**	**84**	**4 079**	**9 151**	**-731**	**-16 114**	**-6 565**	**-8 690**	**-12 483**	**-13 789**	**-14 815**	**-13 903**	**-14 159**

Revenue Forecast

Commercial Airplanes

	2014	2015	2016	2017	2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenue	**59 990**	**59 399**	**59 378**	**58 014**	**60 715**	**11 822**	**4 722**	**8 249**	**9 400**	**34 193**	**73 653**	**71 936**	**68 096**	**71 476**	**73 661**	**71 944**	**71 615**	**73 881**
Growth rate	*n.a.*	*-0,99%*	*-0,04%*	*-2,30%*	*4,66%*	*-22,11%*	*-60,06%*	*74,69%*	*13,95%*	*-43,68%*	*115,40%*	*-2,33%*	*-5,34%*	*4,96%*	*3,06%*	*-2,33%*	*-0,46%*	*3,16%*
Deliveries	723	762	748	763	806	149	90	62	66	367	1 009	961	845	865	875	859	841	849
Growth rate	*n.a.*	*5,39%*	*-1,84%*	*2,01%*	*5,64%*	*-26,05%*	*-39,60%*	*-31,11%*	*6,45%*	*-54,47%*	*175,00%*	*-4,82%*	*-11,99%*	*2,35%*	*1,17%*	*-1,87%*	*-2,16%*	*1,06%*
737 Planes	485	495	490	529	580	89	24	5	5	123	780	723	594	602	609	612	600	605
Growth rate	*n.a.*	*2,06%*	*-1,01%*	*7,96%*	*9,64%*	*-38,62%*	*-73,03%*	*-79,17%*	*0,00%*	*-78,79%*	*534,16%*	*-7,31%*	*-17,88%*	*1,41%*	*1,08%*	*0,61%*	*-2,03%*	*0,87%*
Other than 737	238	267	258	234	226	60	66	57	61	244	229	238	252	263	267	247	241	244
Growth rate	*n.a.*	*12,18%*	*-3,37%*	*-9,30%*	*-3,42%*	*6,19%*	*10,00%*	*-13,64%*	*7,02%*	*7,96%*	*-6,06%*	*3,65%*	*5,96%*	*4,58%*	*1,39%*	*-7,52%*	*-2,50%*	*1,52%*
Revenue per delivery	83	78	79	76	75	79	115	133	142	93	73	75	81	83	84	84	85	87
737 Planes									50	50	50	50	50	51	52	53	54	55
Growth rate	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*0,37%*	*-0,16%*	*0,76%*	*1,73%*	*1,78%*	*1,75%*	*1,87%*	*1,91%*
Other than 737									150	150	151	150	151	154	157	160	163	166
Growth rate	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*0,37%*	*-0,16%*	*0,76%*	*1,73%*	*1,78%*	*1,75%*	*1,87%*	*1,91%*
Market Deliveries	**1 529**	**1 563**	**1 617**	**1 652**	**1 764**	**342**	**348**	**268**			**1 891**	**1 885**	**1 807**	**1 872**	**1 894**	**1 869**	**1 864**	**1 883**
Narrow body	1 153	1 156	1 215	1 260	1 386	253	239	175			1 502	1 475	1 381	1 434	1 449	1 458	1 463	1 476
Wide Body	376	407	402	392	378	89	109	93			388	410	427	439	445	411	401	407
Market Share	47,29%	48,75%	46,26%	46,19%	45,69%	43,60%	25,84%	23,12%			53,38%	50,96%	46,78%	46,22%	46,23%	45,96%	45,09%	45,11%
737	42,08%	42,81%	40,35%	41,98%	41,85%	35,23%	10,03%	2,86%			51,93%	49,00%	43,00%	42,00%	42,00%	42,00%	41,00%	41,00%
Other than 737	63,23%	65,65%	64,10%	59,70%	59,79%	67,29%	60,48%	61,03%			59,00%	58,00%	59,00%	60,00%	60,00%	60,00%	60,00%	60,00%

Defense, Space & Security

	2014	2015	2016	2017	2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenue	**21 413**	**23 708**	**20 180**	**20 561**	**23 195**	**6 611**	**6 612**	**7 042**	**6 755**	**27 020**	**26 792**	**26 532**	**27 142**	**27 468**	**27 875**	**28 729**	**29 421**	**30 113**
Growth rate	*n.a.*	*10,72%*	*-14,88%*	*1,89%*	*12,81%*	*14,01%*	*0,02%*	*6,50%*	*-4,08%*	*16,49%*	*-0,84%*	*-0,97%*	*2,30%*	*1,20%*	*1,48%*	*3,07%*	*2,41%*	*2,35%*
U.S baseline budget	596 400	583 400	584 800	590 200	621 700					664 000	658 400	652 000	667 000	675 000	685 000	706 000	723 000	740 000
Growth rate	*n.a.*	*-2,18%*	*0,24%*	*0,92%*	*5,34%*	*-100,00%*	*n.a.*	*n.a.*	*n.a.*	*6,80%*	*-0,84%*	*-0,97%*	*2,30%*	*1,20%*	*1,48%*	*3,07%*	*2,41%*	*2,35%*

Global Services

	2014	2015	2016	2017	2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenue	**9 468**	**13 293**	**13 819**	**14 581**	**17 018**	**4 619**	**4 543**	**4 658**	**4 963**	**18 783**	**20 379**	**21 973**	**23 542**	**25 063**	**26 511**	**27 983**	**29 329**	**30 522**
Growth rate	*n.a.*	*40,40%*	*3,96%*	*5,51%*	*16,71%*	*8,57%*	*-1,65%*	*2,53%*	*6,54%*	*10,37%*	*8,50%*	*7,82%*	*7,14%*	*6,46%*	*5,78%*	*5,55%*	*4,81%*	*4,07%*
Market Growth Rate CAGR	2019-2024	2024-2029																
	3,40%	*3,70%*																

Capital Corporation

	2014	2015	2016	2017	2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenue	**416**	**413**	**298**	**307**	**274**	**66**	**75**	**66**	**68**	**275**	**243**	**262**	**280**	**305**	**315**	**355**	**395**	**435**
% of Customer financing	*11,68%*	*11,57%*	*7,09%*	*10,02%*	*9,52%*	*2,56%*	*3,25%*	*2,94%*	*2,94%*	*11,94%*	*10,00%*	*10,00%*	*10,00%*	*10,00%*	*10,00%*	*10,00%*	*10,00%*	*10,00%*
Customer financing	3 561	3 570	4 201	3 065	2 878	2 576	2 310	2 243	2 300	2 300	2 425	2 615	2 800	3 046	3 152	3 552	3 952	4 352
Growth rate	*n.a.*	*0,25%*	*17,68%*	*-27,04%*	*-6,10%*	*-10,49%*	*-10,33%*	*-2,90%*	*2,54%*	*0,00%*	*5,43%*	*7,84%*	*7,07%*	*8,79%*	*3,48%*	*12,69%*	*11,26%*	*10,12%*

ROIC Analysis

ROIC Analysis																		
Dollars in millions	2014	2015	2016	2017	2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2019	2020	2021	2022	2023	2024	2025	2026	2027
Core Business Result	5 667	5 372	5 824	8 526	10 724	2 118	-2 950	1 181	837	1 186	8 064	8 685	9 662	11 590	13 050	14 093	14 249	14 703
Invested Capital	29 662	30 016	28 017	23 045	25 434	24 730	21 593	25 930	35 657	36 829	29 791	32 846	34 837	34 476	34 269	34 086	34 931	35 962
ROIC		**18%**	**19%**	**30%**	**47%**	**8%**	**-12%**	**5%**	**3%**	**3%**	**22%**	**29%**	**29%**	**33%**	**38%**	**41%**	**42%**	**42%**
Assets Turn over	306%	320%	334%	408%	398%	93%	73%	77%	59%	217%	406%	367%	342%	361%	375%	378%	374%	375%
Operating Margin	6%	6%	6%	9%	11%	9%	-19%	6%	4%	1%	7%	7%	8%	9%	10%	11%	11%	11%
RONIC			**128%**	**-135%**	**-44%**	**-360%**	**721%**	**-132%**	**-8%**	**4%**	**586%**	**-9%**	**32%**	**97%**	**-405%**	**-503%**	**-85%**	**54%**
RR	n.a.	7%	-34%	-58%	22%	-33%	106%	367%	1162%	99%	-87%	35%	21%	-3%	-2%	-1%	6%	7%
Growth		1%	-7%	-18%	10%	-3%	-13%	20%	38%	3%	-19%	10%	6%	-1%	-1%	-1%	2%	3%

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Buy	Expected total return (including expected capital gains and expected dividend yield) of more than 10% over a 12-month period.
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Sell	Expected negative total return (including expected capital gains and expected dividend yield) over a 12-month period.

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WILL NARROW BODY AIRPLANES TAKE OVER LONG HAUL ROUTES?

SEBASTIÃO SOARES DA CUNHA CORREIA, 33951

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Abstract

Nowadays, smaller airplanes (narrow bodies) in longer flights (long haul) are a new tendency in the airlines' business. To understand this new trend, an analysis of the specifications of each type of airplane was made, as well as a real example, to comprehend what drives airlines into this shift and which are the obstacles an airline may face while using a narrow body in a long haul flight. It was concluded that narrow bodies may be preferable for the shorter long haul flights if airlines can replicate the comfort of a wide body airplane.

Keywords: Long-haul flights, Narrow Body, Wide Body, TAP

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Introduction

There are three major indicators that evaluate the profitability of a commercial aircraft: price, operating costs and capacity. Every airplane has a list price but on average airlines get a 50% discount on this price (Simple Flying, 2019). The operating costs can be divided in maintenance, fees and fuel, which vary widely between airplanes and their optimization is crucial for the profitability of an airline. Capacity can be divided in range, available seats and number of flights, which are crucial characteristics that will decide how much an airline will be able to gain on each flight made by their airplanes.

Narrow Body Vs Wide Body

There are two types of commercial airplanes: wide and narrow bodies. While the wide bodies are aircrafts that accommodate 2 aisles with more than seven passengers abreast and typically have a fuselage diameter of 5 to 6 meters, the narrow bodies accommodate a single aisle and have up to six passengers abreast and its typical fuselage diameter varies between 3 and 4 meters. The wide body aircrafts still in commercial production vary from the Airbus' A380, the 72,7 meters long double-deck aircraft that can carry over 500 passengers in a 3 class seating and fly 15000 kilometers (Airbus, 2019), to the Boeing 787-8, a 57 meters' aircraft that accommodates 248 passengers with a range of 13530 kilometers (Boeing, 2019). The aforementioned wide bodies are usually used for long haul flights (over 6 hours). The narrow body aircrafts can be as small as a three abreast cabin, although the most famous aircrafts of this type are a variant of the Boeing 737 and the Airbus A320, both six abreast cabin airplanes, which are the most sold airplanes families worldwide. Narrow body aircrafts' characteristics have always made them the ideal plane for medium haul flights (between 3 to 6 hours) (AIKA Aviation, 2019)

In table 1 are the specifications of the most sold airplanes worldwide, which demonstrates that the fuel efficiency per seat of the narrow bodies is bigger, which combined with lower fees and

maintenance costs due to the smaller size, lead to a better overall efficiency compared to the wide bodies. It is also possible to understand that the prices of these airplanes are also substantially lower as the average price of a narrow body represents only 36% of the average price of a wide body.

Table 1: Most sold aircraft specifications

Body	Company	Model	List Price ($)	Length (m)	Average Seats	Range (km)	Fuel Tank (l)	l/km	l/km per Seat
Narrow	Boeing	737 MAX 7	99,70	35,56	153	7130	26035	3,65	0,0239
Narrow	Boeing	737 MAX 8	121,60	39,52	178	6570	26035	3,96	0,0223
Narrow	Boeing	737 MAX 9	128,90	42,16	193	6570	26035	3,96	0,0205
Narrow	Boeing	737 MAX 10	134,90	43,80	204	6110	26035	4,26	0,0209
Narrow	Airbus	A319neo	101,50	33,84	150	6850	26730	3,90	0,0260
Narrow	Airbus	A320neo	110,60	37,57	180	6300	26730	4,24	0,0236
Narrow	Airbus	A321neo	129,50	44,51	220	7400	32940	4,45	0,0202
Average			118,10	39,57	183	6704	27220	4,06	0,0222
Wide	Boeing	787-8	248,30	57,00	248	13530	126206	9,33	0,0376
Wide	Boeing	787-9	292,50	63,00	296	13950	126372	9,06	0,0306
Wide	Boeing	787-10	338,40	68,00	336	11750	126372	10,76	0,0320
Wide	Boeing	777X-8	410,20	69,79	384	16170	158940	9,83	0,0256
Wide	Boeing	777X-9	442,20	76,72	426	13500	197977	14,66	0,0344
Wide	Airbus	A330-800neo	259,90	58,82	260	15100	139090	9,21	0,0354
Wide	Airbus	A330-900neo	296,40	63,66	300	13400	139090	10,38	0,0346
Wide	Airbus	A350-900	317,40	66,80	350	15000	141000	9,40	0,0269
Wide	Airbus	A350-1000	366,50	73,79	410	16100	159000	9,88	0,0241
Average			330,20	66,40	334	14278	146005	10,23	0,0306

Source: Airbus and Boeing websites

The future

Currently, there is a new tendency in the airlines' business, as Boeing and Airbus are highly improving their narrow body's range and number of seats while also reducing fuel burn, airframe maintenance costs and CO_2 emissions, via the new A320neo (produced by Airbus) and 737 MAX (produced by Boeing) families, that assure a 20% fuel improvement per seat compared to their previous models (Airbus and Boeing, 2019). Airbus' longest range narrow body at the moment is the A321 Long Range (LR) with the capacity of reaching 7400 kilometers, able to accommodate over 200 passengers. As for Boeing, its longest range aircraft is the 737 MAX 7 that can fly 7130 kilometers, accommodating only around 153 passengers

aboard. With these new models, airlines can easily fly several long haul routes with higher efficiency levels than with wide body airplanes due to a lower cost per seat.

TAP's example

TAP represents an important sample in this tendency, showing the appropriateness of the narrow bodies to intercontinental routes, as the Portuguese airline's president said in April 2019 "*The A321LR is critical for TAP's expansion plans. With its superior range, we can comfortably explore markets in North America, South America, and Africa from Portugal, and it'll fit in seamlessly with our A330neos*". The airline is already substituting the 12000 km range A330-200 for the 7400 km range narrow body in its already existent transatlantic routes to North and South America, while opening new routes to the same destinations that are intendent to use this new aircraft (TAP, 2019). Using TAP as an example is not a case of home bias, since this airline has important characteristics for this analysis. Firstly, TAP's base location is Portugal, making it obvious for the airline to explore transatlantic routes due to the geographic location of the country. Secondly, the airline received the first A321LR ever produced and third, the company is eager for more efficiency to achieve better results.

Table 2: Specifications of the two TAP models

Model	Seats	Range (km)	Fuel Tank (l)	l/km	l/km per seat
A330-200	266	12000	139090	11,59	0,0436
A321LR	168	7400	32940	4,45	0,0265

Source: TAP website

The specifications of each aircraft, shown in table 2, make this choice easier to understand, because even though flying TAP's A321 instead of the A330 makes the airline lose 98 seats per flight, this is highly offset by the reduction in the fuel consumption by seat. Flying the narrow body costs about 60% of the fuel price per seat while flying the wide body, which represents a key change that allows airlines to increase profitability. Although there is a loss in seats per flight, the use of a narrow body and its lower cost allows an airline to increase the number of flights for each route, which can make the number of seats in that route increase while letting customers choose between a bigger number of schedules.

In table 3 are the figures of TAP's route between Porto and Newark, that represents a good example of this change, tripling the route's frequency resulting in a 90% increase in seats to the American continent and back to Portugal. The total fuel burn per seat decreases 40%, creating an overall increase in fuel spending of 15%, which is very low when compared to the increase in seats. It is easy to understand that there will be other costs that will increase due to the higher number of flights, such as fees, food or flight crew costs but these costs will only partially offset the effect of the reduction in price per seat, making this change of airplanes a gain in efficiency in terms of costs.

Table 3: Porto to Newark route figures

Model	Seats	Flights per week	Seats per week	l/km per seat	Distance (km)	Total fuel per seat (l)	Total fuel (l)
A330-200	266	2	532	0,0436	5374	234,17	124578
A321LR	168	6	1008	0,0265		142,39	143529

Source: TAP's website and routes online

After the cost structure, it is important to look into the demand and analyse how this change will affect it. Airlines do not have fixed prices for each route, since there are many conditions on fare prices, one being the number of seats aboard the aircraft that still have no passengers. An empty seat in an airplane is an inefficiency that reduces the company's revenue, thus an airline will be willing to reduce prices in order to have every seat occupied, and as long as the price of that seat is over the costs incurred to have a person sitting in there, selling this extra seat at a lower price will increase profit. This is another advantage the narrow body aircraft provides to TAP, since having a fully occupied A330 might be hard due to the high number of seats, especially during the low demand seasons, while having a fully occupied A321LR is easier, meaning that the airline will not need to lower prices to have a full airplane as much as it would while using the wide body.

Another matter to take into account when comparing a narrow and a wide body in a long haul flight is comfort. Due to its characteristics, it may be hard to replicate the comfort of a wide body in a smaller airplane, since the cabin width of the A330-200 can be 5,26 meters long, and the A321LR cabin can only reach 3,7 meters, which combined with the extra 5,63 meters in

height means a big reduction in space. While this might not be a problem for a three hours' flight to European country, it certainly may be a problem in flights that take over seven hours to North or South America. There is a clear trade off here for airlines between the comfort of its clients and the number of seats inside the aircraft. While an A321 can have 244 economic class seats and the normal 2 class seating varies between 180 to 220 seats, TAP's A321LR only has 168 seats and with a 3 class seating, the airline is able to do a good price discrimination while still not making its client go through a seven hours' flight with lack of space. When comparing the standard areas for the seats of TAP's A330 and A321, it is possible to understand that the difference in the seat pitch (distance between each seat) is only 7,88 centimeters in favor of the wide body while the seat width is about the same for both (TAP, 2019). This shows that as long as airlines can control their greed for profits, that can only be fulfilled at the cost of passenger comfort, a narrow body airplane may be the best option for many long haul flights.

Conclusion

Although wide body aircrafts will still be flying most of the long haul flights, due to the new narrow body airplanes' flexibility and lower costs, some of these longer flights will be flown by these airplanes. The higher profitability per seat will lead to this shift of airplane use by airlines specially in routes with lower daily passenger density but also in routes with higher density, through the creation of a larger number of flight schedules that may better suit customer's preferences. This tendency will keep increasing with technological advances that will allow aircraft manufacturers to continue increasing the range of its narrow bodies.

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